UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
WESTERN DIVISION

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UNITED STATES OF AMERICA,	:	CASE NO. 1:18-cr-0043
Plaintiff,	:	**EVIDENTIARY HEARING**
vs.	:	
	:	23rd of August, 2022
YANJUN XU, also known as XU YANJUN, also known as QU HUI, also known as ZHANG HUI,	:	10:34 a.m.
Defendant.	:	

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TRANSCRIPT OF PROCEEDINGS
BEFORE THE HONORABLE TIMOTHY S. BLACK, JUDGE

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APPEARANCES:

For the Plaintiff:

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And

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And

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Also present: Robin Murphy, Interpreter
Mae Harmon, Interpreter
Yanjun Xu, Defendant

Law Clerk:	Cristina V. Frankian, Esq.
Courtroom Deputy:	Rebecca Santoro
Stenographer:	Lisa Conley Yungblut, RDR, RMR, CRR, CRC United States District Court 100 East Fifth Street Cincinnati, Ohio 45202

Proceedings recorded by stenotype.
Transcript produced with computer-aided transcription.

(Proceedings held in open court at 10:34 a.m.)

THE DEPUTY: All rise. This United States District Court for the Southern District of Ohio is now in session, the Honorable Timothy S. Black, District Judge, presiding.

THE COURT: Thank you. Please be seated. Good morning. We're here in the open courtroom on the record in the criminal docket in the case of *United States versus Xu*. Let me make a brief statement, but before I do, I would like, for the record, people to enter their appearances. I know who you are, but for purposes of the record, would the attorneys for the United States identify themselves and anybody sitting with them?

MR. MANGAN: Good morning, Your Honor. Tim Mangan on behalf of the United States. With me at counsel table is Emily Glatfelter and Matthew McKenzie.

MS. GLATFELTER: Good morning, Your Honor.

THE COURT: Good morning to the three of you. And on behalf of Mr. Xu?

MR. MIEDEL: Good morning, Your Honor. Florian Miedel on behalf of Mr. Xu and also Jeanne Cors and Sanna-Rae Taylor.

THE COURT: Good morning to the three of you. The defendant is seated next to you and with the interpreter in between you; is that right?

MR. MIEDEL: Yes.

THE COURT: Did he respond?

INTERPRETER MURPHY: Good morning.

THE COURT: Good morning to the interpreter as well. Do we need to swear the interpreter? Madam Interpreter, you're going to survive. Good morning. Thank you. I need you to take the oath to tell the truth.

Do you solemnly swear or affirm that you will accurately and truthfully translate these proceedings today subject to the penalty of perjury?

INTERPRETER MURPHY: Yes, Your Honor.

THE COURT: Thank you. You may be seated. If at any time you need a break or you need to go back, just let me know. The Court and the community appreciate the work you're doing.

INTERPRETER MURPHY: Thank you.

THE COURT: Who is the individual behind counsel's table, not Ms. Cors, Counsel. No, your table.

MR. MIEDEL: Oh, Mae Harmon, who is also an interpreter.

THE COURT: She's retained by the defense?

MR. MIEDEL: That's correct.

THE COURT: Good morning.

INTERPRETER HARMON: Good morning, Your Honor.

MR. MIEDEL: Your Honor, just before we get started, I would ask for Mr. Xu to be unshackled as he was

during the trial. He's going to be taking some notes. He's going to be corresponding or talking with us, and it makes it easier, if it's okay with the marshals and the Court.

THE COURT: You're talking about hand shackles?

MR. MIEDEL: Yes.

THE COURT: Well, let me tell you the truth, the United States Marshal is in charge of security in this courtroom, not me. Their standard policy is that people remain shackled. In this case, he's a convicted felon and the policy would be retained to keep him shackled by his hands. I suspect it's in my discretion.

Does the marshal wish to be heard? I'll put you right on the spot. Go ahead. If you'll tell me your name for the record, please. I know your name.

MS. KAY: Yes, Your Honor. Sarah Kay with the marshal service. We didn't have any issues with him at trial, so I'm fine either way. Whatever the Court would like, we are fine with.

THE COURT: Very well. You may remove the hand shackles. If you would assist.

MR. MIEDEL: Thank you, Your Honor.

THE COURT: Very well.

(Pause.)

THE COURT: The task has been accomplished. I wish to make a brief opening statement and then we'll proceed.

On November 5, 2021, following a jury trial, Defendant Xu was convicted of four criminal counts, including conspiracy to commit and attempting to commit economic espionage, Counts I and II, as well as conspiracy to commit and attempting to commit trade secret thefts, Counts II (sic) and IV.

Are the interpreters interpreting -- is the court interpreter interpreting for the defendant as I speak or are you waiting to try and cough out my entire sentence?

INTERPRETER MURPHY: Your Honor, I'm going simultaneously.

THE COURT: Very well. Thank you. Am I going too quickly?

INTERPRETER MURPHY: No, you're fine, Your Honor.

THE COURT: You'll raise your hand if I am?

INTERPRETER MURPHY: Yes.

THE COURT: Particularly as to the witnesses, correct?

INTERPRETER MURPHY: Yes.

THE COURT: Very well.

After the jury trial and the convictions, the Court ordered the preparation of and has since received a thorough, written presentence investigation report, as in all cases. At the time of sentencing, the Court, this Judge, will rely upon the information set forth in the

presentence report, among other things, in the Court's consideration of the 3553(a) factors.

One of the factors the Court must consider is what the guidelines recommend. The guidelines are an effort by Congress to bring consistency, similarity, sameness, to federal sentences across the country. Here, due to the nature of the charges, a primary driving force of the guideline computation is the loss amount. The government asserts, and the PSR agreed, that the loss amount here is $107 million. The defense objects to this figure and I believe asserts that the loss amount is zero. Accordingly, the parties requested that this Court hold today's hearing in order to receive evidence that will hopefully assist the Court in making a final determination of the loss amount prior to sentencing.

You will recall that I was here every day during the jury trial. I want to be clear that this Judge sat through the entirety of the trial, heard all of the evidence. The jury convicted the defendant of all four offenses beyond a reasonable doubt. For purposes of sentencing, judicial findings of fact are based upon a preponderance of the evidence standard.

So today's hearing will not be an opportunity for the parties to restate their evidence as to guilt. Rather, the government must offer evidence to support its loss amount,

and if the defense disagrees, defendant must produce some evidence that calls reliability or correctness of the loss amount into question. This burden of production requires more than a bare denial. My interest today is understanding how the parties propose this Court should value the loss amount, if any, in this case.

Under the guidelines, the loss amount is defined as the greater of actual loss or intended loss. Court may also look to the actual or reasonably foreseeable pecuniary harm or the gain to the defendant or others from the offense. So that's what I'm focused on here today.

Are we ready to proceed from the government's perspective?

MR. MANGAN: Yes, we are, Your Honor.

THE COURT: And from the defense?

MR. MIEDEL: Yes, Your Honor.

THE COURT: Very well. I want you to tell Mr. Kohnen that I miss his presence. He's an outstanding trial lawyer.

MR. MIEDEL: We will certainly do that.

THE COURT: Very well. On behalf of the government, do you have evidence you wish to present at this time or precede it with argument?

MR. MANGAN: Yes, Your Honor. The way we propose to proceed would be to call one witness from GE, Mr. Nick

Kray, who testified previously at trial. That would be to support the evidence that we had submitted regarding the cost of development, which is what supports that particular number in the PSR. We would also propose being able to follow up with -- and this could either be in our sentencing memorandum or in a post-hearing brief, but a summary of our position on the loss, the overall loss amount. That would not only summarize our views on what transpired today, but also help show why this sentencing range is reasonable for the Court to adopt, even if you adopt -- even if you look at other approaches, such as what the overall market value might be for these sales.

But today we're going to focus on -- what we're going to present relates to the cost of development, which is one of the primary factors cited in the guidelines.

THE COURT: Very well. I wish to give the parties an opportunity after today to present argument in writing to me. I will miss oral argument today, but, surely, you understand.

MR. MANGAN: Understood, Your Honor.

THE COURT: Very well.

MR. MANGAN: Then, Your Honor, if we would proceed by calling Mr. Nick Kray from GE.

THE COURT: If that gentleman would approach. We're going to come up here. You can just leap over the

barrier.

(Witness took the stand.)

THE COURT: If you would be willing to pause where you are for the oath to tell the truth. If you would raise your right hand. Do you solemnly swear or affirm that your testimony today will be the truth subject to the penalty of perjury?

THE WITNESS: I do.

THE COURT: Very well. You may be seated. Seat tips back. The microphone is expensive, use it.

THE WITNESS: Okay.

THE COURT: And I have a transcript of every word you said in this courtroom.

The government may proceed.

MR. MANGAN: Thank you, Your Honor.

NICK KRAY

of lawful age, Witness herein, testified as follows:

DIRECT EXAMINATION

BY MR. MANGAN:

Q Mr. Kray, since you already testified in this case, I'll try not to be too repetitive.

THE COURT: Let the record reflect that.

Q All right. But to refresh our memories, can you state what your role is at GE Aviation?

A Yes. I'm currently a chief consulting engineer,

specific to composite design.

Q And is composites your area of speciality?

A That is correct.

Q All right. At trial you explained how those composites worked with fan blades and encasements. Can you just remind us, when did GE first use composite fan blades?

A So composite fan blades started in early the 1990s, specific to our GE90 dash 94B triple fan engine that was certified in 1995 and delivered to our first customer in 1995. That began a legacy of several other developments that built upon that experience.

Q And then when did GE add a composite case?

A First composite case was on the GEnx engine, which is the second predecessor after GE90-94B, that was in about a 2002, I think, time frame.

Q All right. And just still today, are there any other commercial engine manufacturers that have an engine in the air that has composite fan blades and a composite case?

A No other competitor has certified a composite fan blade/case combination.

Q All right. Now, how long have you been involved in the design/development of the composite engines at GE?

A I started in 1997/'98 time frame on the initial GE90-115B program, which was the second program after the initial 94B program.

Q Okay. You were talking about the GE90 engines. Then, was there a series of engines called the GEnx engines?

A Yes. The lineage that we have is: The GE94B was initial, the GE90-115B followed that, the GEnx-1B, followed by the GEnx-2B, and most recently GE9X.

Q All right. And were you part of the work on the composite fan module in those engines?

A Yes, correct.

Q All right. And then just for background before we turn to sort of the development process, when GE has already developed an engine that is successful and employs these composite parts, why do you need to design and come up with new engines?

A Well, there's a couple, couple reasons. The first one is any engine design is really specifically tailored towards an air frame, whether it's a triple 7 or a 787, so typically, we have to tailor the performance of the engine, the thrust rating, to fit the air frame or our customer, whether it be Boeing or Airbus.

The second reason is that certainly economics of performance, performance is very critical to our customers, so the better we can perform an engine, make it take less fuel or fly farther, is very critical to our competitive advantage to sell that engine.

Q Okay. So let's talk a little bit about what that

design process is for a new commercial engine at GE. Are there multiple design teams involved in that process?

A Yes. Our engines are typically built in what we call modules. There's a fan module, which is up in the front of the engine, which is the area we're concerned about today. But there's other modules, the compressor module, the combustor module, the high-pressure and low-pressure turbine module. So there are these module teams, if you will, that design specific areas of the engine.

Q All right. And then are there also individuals that work on certain parts of development, such as materials or testing or certification?

A That's correct. So in addition to the module teams, you have performance teams that strictly deal with aero performance, you know, how well a blade can pump air, for example, or how well a combustor can work its combustion and fuel, you know, usage. And then there's materials folks all that deal specifically in materials to support those modules, if you will.

Q All right. So let's focus in on the fan module, all right?

A Um-hmm.

Q Is that the area where you specialize?

A That's correct, yeah.

Q And that's -- when we've been talking about the fan

blades and the composite cases, that's all in this fan module section?

A That's correct. There are several I'm going to call -- things that you can consider to be composites throughout the engine. The composites we're dealing with here are called polymeric composites, which are typically a lower temperature usage, which would be a fan module. Our ceramic composites, which are in the back of the engine, can survive much higher temperatures. They're still considered composites, but they're a different. There are different criteria to make those designs work versus the fan module.

Q All right. Within the fan module, are there different teams for performance versus mechanical?

A There typically is. I mean, any module will have the mechanical team, which is most of the making the actual structures work, but then there's performance teams, there's system integration teams. Yes.

Q Okay. The group that you're typically in, what team is that called?

A Mechanical.

Q All right.

A Mechanical design.

Q Let's talk about the mechanical design team for the fan module on a new engine, okay?

A Um-hmm.

Q Typically, approximately, how many people are on that specialized team?

A It can vary. It's typically closer to anywhere between five and ten people --

Q Okay.

A -- specifically for the mechanical.

Q All right. And is that the team that's focussing on the composite blades and the case?

A That's correct.

Q All right. You mentioned that the GE9X is the most recent engine that's been developed?

A Correct.

Q All right. Approximately, how many people were on that mechanical design team?

A I think mechanical design was seven.

Q All right. And were you part of that seven?

A I don't fall into that head count. Since I'm a chief consultant engineer, I kind of float between several programs across GE Aviation, but that would be seven dedicated individuals specific to the 9X program.

Q All right. Do you recall the GE employee who is sort of at the center of this case that met with Mr. Xu --

A Yes.

Q -- Mr. Kray?

A Yes. Daihui Zheng.

Q Was he one of the members of that small team?

A Yes.

Q All right. And if someone is part of that small mechanical team for the fan module, do they have access to all of the information that the other members of the team have?

A Typically, it's a very open environment for that design team. They would share obviously conversations because they all sit in the same proximity of each other, but our computer systems are also set up to have shared directories where we store files that everybody would have access to as well.

Q Okay. So at least within that core mechanical design team, there is -- the information is shared within them?

A Yes, certainly, it would, design information as well as test data, test results, that sort of thing.

Q Are you familiar with the term at GE called a "key technology"?

A Yes.

Q And how is that term used?

A So internally in GE Aviation, we look at -- we classify different technologies across the turbine fan engine as critical to our competitiveness. Key technology would be things -- such things as composites, polymeric composites, specifically fan blade/fan case interactions.

Other examples would be things such as CMCs in the back of the engine.

Q And this design -- mechanical design team that focuses on the fan module, would they be involved in using that key technology?

A Yes, certainly.

Q All right. Did you review the directory of Mr. Zheng's GE laptop --

A Yes, I did.

Q -- that was at issue in this case earlier?

A Yes.

Q All right. And in that file directory, did you -- were you familiar with a number of those file names and what they meant?

A Yeah, I did a pretty thorough search of all of the files, and, yeah, pretty familiar with what was on there, yes.

Q Did they pertain primarily to the 9X engine?

A Yes.

Q And did they pertain to the work of that fan module mechanical design team?

A Yes. A lot of mechanical design files as well as manufacturing files, you know, how the case was made with our vendors.

Q All right. Were you asked to estimate GE's cost of

development for developing a new commercial engine that would include composite fan blades and encasements?

A Yes, I was. I specifically focused on the fan module assessment.

MR. MANGAN: All right. Your Honor, at this point, we would like to have him go through what's been marked as Exhibit A. This was submitted as part of the PSR, and I believe you have a copy.

Your Honor, we would like this material to stay under seal, if we could.

THE COURT: Very well. Order this material sealed, unless there's an objection at this time from the defense.

MR. MIEDEL: No, Your Honor. We don't think that this --

THE COURT: Very well.

MR. MIEDEL: All right.

Q All right. Do you have a copy of what's been marked as Exhibit A in front of you?

A I do.

Q All right. And is this -- looking at page 1, is this the estimate that you worked on creating?

A Yes, it is.

Q All right. So before we turn to the cost part of developing that part of the engine, can you explain for us -- using perhaps that block on the top left, the pyramid,

can you explain for us the steps involved in the process?

A Sure. So if we focus on the upper left area here, call it development Building Block approach, this is a well-known approach in industry. It actually comes from *Composite Materials Handbook 17*, which is an industry standard for composite design. And really it shows here how you basically start from a very lower-level design approach, coupon level evaluations, and then you proceed into more complex designs and testing to validate your lower-level assumptions, and it builds up to more and more complex full-level assessments of any type of component you would design.

Q So starting at the bottom where it says "Block 1, Material Screening and Selection," roughly, what is involved in that, that stage?

A So, typically, the thing -- unique thing about composites is there's a multitude of fibers and resins and architectures that apply. Unlike metals, which are very limited to certain types of metals for your applications, composites has a much bigger sand box to play in. So trying to down-select how to combine these fibers and resins to meet your objectives or your design criteria in a most efficient way feeds into that material down-select.

Q Okay. You talked about "down-select." How is that -- what do you mean by that phrase?

A So when you say "down-select," again, multiple candidates that would satisfy your requirements. If your requirements are for containment or for fatigue, et cetera, there's a multitude, multiple combinations of things that would meet that. What you try to do there is to pick the best candidate for weight, for meeting all of the criteria at the same time and be durable.

Q All right. You mentioned coupon testing. Does that mean you're talking about testing a very small, small section that you're testing?

A That's correct. A coupon is -- typically starts out with a very small, you know, flat plate-type of coupon where you'll do rudimentary type of testing to validate material properties, characteristics of the material, how it interacts, what is the best architecture, you know, whether it's a braided or a woven or a lay-up of different composite angles, what is the best combination or how you -- it's really understanding the physics of all of that that you can make that down-select process.

Q Then, eventually are you actually coming up with a shape for your fan blade?

A That would typically come up in the higher levels up here. I guess you'd call it Block 4 and 5, is where you actually start getting into the more of an, okay, I have a candidate material, now I have to see how it does in an air

flow shape, for example, or a containment case where I have a limited thickness, you know, how well does it absorb energy.

Q Okay. So sounds like there's a lot of work at the beginning to get the right material, get the right combination, before you get into the shape of the blade?

A Exactly, yeah.

Q All right.

A And, again, you know, I think when we started to do the 94B, there was probably 15 different type of materials that we were looking at as initial candidates that we down-selected to a single one.

Q All right. And it's that critical; if you pick the wrong horse at the beginning, that could impact whether it's ultimately successful?

A Yeah. The problem there is you could pick the wrong horse, you might get through the coupon testing okay, you might down-select, but then as you get to higher and higher complex levels of design, component level, the architecture, the bigger blades, you might find out you're wrong, and then you have to go back.

Q Okay.

A The thing about composites is they're not always scalable. We call it scalable. If you go from a coupon to a full-size structure, you may lose some of that type of

scaleability in the understanding of the material system.

Q All right. Let's turn to the development timeline that you have over in the larger blue box; do you see that?

A Yes.

Q Okay. The very first item on the left there where it talks about material property data and down-select, is that the process that we've just been discussing related to the material selection?

A That's correct. That would be the coupon level where you're trying to sort out again the architectures and the right material slash, you know, resin slash fiber combinations.

Q And for that, you've got roughly five years; is that correct?

A That's correct.

Q Is there some variability there if you've already got some material you like versus if you're starting with a whole lot of candidates?

A Well, certainly, there would be variability there, right, if you have an existing material system. For example, on our fan blades, we have an existing material system that we've leveraged for a couple of programs, that timeline would certainly be potentially shorter.

Q All right. So if you've already got that material and you're going to use that same material, you're really

starting at the -- at that line that you've got, that vertical line at the five-year mark?

A You would save an appreciable amount of time, yeah.

Q All right. And how did you estimate the cost related to the material selection?

A So fees and tech cost is certainly labor, and our labor costs, I'm ballparking it, about 200 or $250,000 per what we call man year, which is one person working full-time for an entire year. So that's $250,000. If you think there's a couple of people there working for five years, that's, you know, 5, 10 man years at 250, that's $2-and-a-half million there. Then, you have all of the material costs themselves, the processing costs, and all of the tooling that goes along with that.

Q All right. Let's turn to the next arrow that's down. It's called Design Labor Manpower?

A Um-hmm.

Q Is that seven people for seven years?

A Yes. So that's --

Q What are you referring to there?

A That is seven people for seven man years, if you will, seven people working full-time for seven years.

Q All right. And what is that referring to; is that the mechanical design team for the fan module?

A Yes. So we talked previously about, you know, the

design team. That was the seven people that were involved in the latest program, the GE9X, and that 9X took seven years to do that mechanical design.

Q Okay. So with respect to this small team, seven people, it takes more than seven people to design an engine, correct?

A Certainly. Again, this is just the mechanical design team of the fan module. All right. So you've got other people. You've got the systems, you've got the aero folks, you know, it's -- when you talk about the whole engine, you're probably talking 200 people, 250 people, 300 people. It's a big effort. This is very specific to mechanical design.

Q All right. And then the amount that you estimated there, that was based on the labor costs related to the seven individuals?

A That's just a hundred percent labor, yes.

Q Okay. The next line down is the Material Property FAA Characterization. Explain what that is.

A Okay. So for any new material system that you put into an engine, whether it's composites or a metal that may not have been used in the past, you have to do a certification program to the FAA. It's supported by a Part 3315 report that has to be submitted to the FAA which fully characterizes that material so that you prove to the

regulatory agencies that you fully understand the material, it's supported by several lots of -- say "lots" of material, it's different -- when the material gets manufactured at the material manufacturer, they make it in batches, lots, if you will, and it requires several different lots so you make sure you characterize -- that you don't maybe get one lot that might vary over time, if you make it again six months later, it might be different. So you have to have a big spread of material characterization that you don't get surprises down the road.

Q All right. And how did you estimate the cost for that section?

A Okay. So that $2 million cost is based on two material systems. It's what we have in the 9X. There's a new material system for the fan blade and a material system for the fan case. Typically -- and this is historically our number -- it's about a million dollars per material to make that 3315 Report and all the supporting data behind it.

Q All right. The next arrow says "Subcomponent Testing."

A Um-hmm.

Q Which if we go back over to the triangle, that's roughly Block 5, right, so we're pretty far along. Can you explain what the subcomponent testing is?

A Okay. So we talked about as you progress from the

coupon level to the component level or subcomponent level is where you start getting into the architectures of the actual component you're designing. So whether it be a fan blade or maybe a fan blade dovetail or a fan case thickness, geometry distribution, architecture, that's when you would actually make those components and do component testing on them, whether it's shooting projectiles at a flat plate or a curved plate or shooting birds at an air flow shape to characterize that material system under more representative geometries and engine environments.

Q So there's a period of time where you're doing incremental testing on larger and larger samples?

A That's correct, yes.

Q All right. And you estimated about a half a million for the subcomponent testing?

A Correct. That's just for the testing because, again, all of the labor that's on the man hour bar kind of supports that.

Q All right. The next section is the containment rig testing, and then it says "3 rigs." What is that?

A So, you know, with the fan module, one of the biggest design hurdles for that system to work is containment of a released blade. It is a requirement by the FAA that we have to demonstrate that that happens. So you have to do a final test of that release and containment. You don't want the

blade to exit the engine and cause fuselage damage.

All right. So typically what we do as we get higher and higher confidence at the subcomponent level that the architectures are going to work, then, we would progress into these containment rigs. And that rig is essentially a fully bladed rotor which has our composite blades in it and a composite shell encasement around it, and that is spun up to our high-speed take-off speed, and that blade is then intentionally released in that event, and we capture a couple of things. Obviously, we capture containment, you know, binary, yes, it did contain or not, but also all of the associated -- you know, how does it absorb energy, what is the case deformations, how does the blade fragment. All of those things get put into the rigs.

That is what we call an engineering rig. It's not visible to the FAA. It's not visible to -- a lot of times not even to our customers. We do it internally as a learning exercise. And, typically, it takes more than one rig because you learn and you have to adjust designs. And in our case of the GE9X, it took three rigs to do that understanding. Again, a rig is just a very -- the conditions are not like a full engine because a full engine is very expensive, but it's just testing that encasement/blade combination.

Q So this containment rig testing where you're going

through these rigs for the blade-out, is that just testing the fan module; it doesn't have the other pieces of the engine?

A Just testing the fan module, that's correct.

Q All right. And it could take more than three rigs, but that's what you estimated here?

A Yeah. Well, three rigs was based on the GE9X, that's what it took there. Other experiences we've had -- and I go back to the GE94B, I think we were several rigs, I think we were probably four or five rigs. So, again, as you learn more and more about how to get from Point A to Point B, you can make that trip faster.

Q Okay. And this is obviously more expensive than some of the other items, is that because it involves the destruction of the material?

A Yes. So certainly it's a destructive test, so you damage, you know, a whole set of development fan blades, which can be very expensive, and a development case, which obviously is also very expensive, and it takes time. I mean, each one of these rigs is probably a six-month effort, dedicated effort, just to get all of the test blade hardware designed, all of the balancing, all of the coordination with the test facility. These are run in big vacuum vessels, so big containment, you know, structure for safety, because if you have a surprise in the test, you don't want to, you

know, harm anybody. So these are very, very complex tests.

Q All right. And then as we're moving along the timeline, we're getting towards the final stage. What happens after you get through the containment rig testing and you feel you're ready for the next step?

A Yeah. Once you do your containment rig testing and you're confident, so now you have a fan module that you're happy with, again, that now has to be validated to the agencies, the FAA, that indeed it meets the requirements for containment. So that is now a certification test to meet -- I think it's 3379 for containment, and you actually have to demonstrate that on a full engine.

All right. So that is now -- this last part here is a full engine test, which has to release a fan blade at top speed and show basically that you can contain and you don't have a fire and/or you don't release the engine from the mounting structures, et cetera.

Q All right. So this final containment certification test, the fan module is now affixed with the full engine, correct?

A Correct.

Q But the test itself, is that still focused on the blade-out event?

A Yes.

Q And the containment?

A That is one of the main things of the test. Certainly, other things are tested at the same time, right, because it's now a system. I have the whole engine behind me, behind the fan module, so, again, the mounting structures, all of the loads that get generated during this big dynamic event of a blade release, have to show that they can also survive.

Q Okay.

A Yeah. Again, it's a very high-cost test. It is a complete demonstrator engine, and at this phase, the engine is not, I'm going to say, industrialized. So there's a lot of development work that goes into it and it's very expensive at that point.

Q All right. Mr. Kray, I realize this was an exercise in estimating a general development scheme. Overall, what was the timeline that you came up with for a hypothetical engine development like this?

A Typically, it's on the order of, you know, getting close to 15 years, you know, 12 to 15 years when you start way back from, you know, material. If you were to start from zero, it would be on the order of 12 to 15 years.

Q And if you're starting with the material, there's still at least seven years of this testing?

A Oh, yeah. Even if you had the right material system, some of these tests are required for certification.

Q All right. Okay. Now, before we turn from this, I do want to mention this timeline and cost estimate. First of all, what was the total that it added up to in your estimate?

A $107 million.

Q All right. That $107 million and that time frame, that's relating to a successful development of an engine, correct?

A That's correct.

Q If the wrong material -- and I say "wrong." If a material is selected that turns out to be incorrect, that would impact this, correct?

A Oh, certainly, yeah.

Q Would the timeline be longer?

A Certainly, yeah.

Q Would the cost be higher?

A Oh, yes.

Q All right. I guess any time the timeline -- any time you have to start over, you're going to increase the cost?

A Right. And remember that -- this may be not shown in this diagram -- that, you know, typically when these programs get launched, we have commitments to our customers, whether it be Boeing or Airbus, to supply an engine to an aircraft. So in parallel, they're designing an aircraft, for example, and that timeline is very, very rigid because

they have commitments. They typically sell an aircraft before it's even completely designed, and they have commitments to their customers, who are the American Airlines, the Deltas, et cetera.

So a lot of timelines are very, very rigid with respect to commitments. If you were to have to go back and redo some of this testing, commitments can be very -- the schedule gets very -- a lot of, a lot of scrutiny, and that can be very costly from a penalty perspective, whether it be an Airbus that has an airplane sitting there that doesn't have engines to go on it or a customer is waiting that has built a business plan for a triple 7, for example, that's not in its hangar because Boeing hasn't delivered it to them.

Q Are aware of competitors that have invested money in trying to develop something similar and have either stopped or failed or had to restart?

A Yes. So one of the industry-known examples is Rolls Royce on the RB -- RB211 program, and I believe it was in the '70s, 1970s, I think, they tried to do a composite fan blade for that program. They were not successful. And they tried it twice, and the second time, they almost bankrupted Rolls Royce corporation because of those commitments and time frames that were dedicated to that.

Q All right. And so since GE is the only manufacturer

that currently has a certified engine that's in the air like this, this is essentially the shortest that it's ever been done; is that fair to say?

A I would say yes, because the 94B took much longer than that --

Q All right.

A -- because it was our first time through.

Q So it can be much longer if it runs into problems or is unsuccessful?

A Yes.

Q Or it could just flat-out fail and a competitor could just never reach the finish line, is that possible?

A Or you would have to -- as in Rolls Royce's case, they had to go back and put a metal fan blade on that, so their performance did not meet their commitments, and there are certainly penalties they have to pay for that.

Q All right. Thank you. Let me turn to page 2 of this exhibit, and can you just describe for the Court -- we won't go through every single line, but can you summarize -- and we won't go through all of the math. But if you could start by summarizing for the record what does this show and what was it that you were trying to capture?

A Okay. So what we tried to capture here was that over and above the development costs, what is our value to the customer? In other words, why would the customer pay for a

GE engine versus a competitor's engine, which I captured here. This is really our -- what I call customer value. And composites, as we talked about, the real advantage of composites is weight, and the composites fan case/fan blade combination here saves us approximately 200 pounds per engine. All right. And there's two engines on an aircraft, at least most aircrafts, 747-800 has four, but most aircraft have two.

So it's really -- I worked with our performance folks to try to capture the customer value here. And as you take weight out of the engine, you get -- it takes less fuel, obviously, because it's a lighter aircraft. So I can -- either I can save on fuel costs or I can go longer routes, so I can have a better structure for my airline customers. And that's what I tried to build here, is the SFC, specific fuel consumption, advantage of a lighter weight aircraft.

Q I'm sorry, in the end, what did you estimate were the savings for that aircraft?

A Okay. So if you take the typical life-span of an aircraft, which is 35 years, and that's industry standard, it's about $1-and-a-half million of savings just on operational costs to our customer for every aircraft that has composite fan blades and fan cases on them.

Q That's just on the fuel side of it?

A That's correct.

Q All right. If they wanted to take that weight and use it to have more seats or something like that, is that another way that a manufacturer could utilize the value?

A Sure, yeah. Certainly, yeah.

Q All right. And this is simply for one aircraft over its lifetime?

A That's correct.

Q All right. Do you know how many GE engines with composite fan blades are out there, roughly?

A Yeah. So we have four variants, as I mentioned earlier, GE90-94B, GE-90-115B, GEnx 1B, and GEnx 2B. The GE9X is certified but has not made it to the customers yet. But between those four variants, there's over 2,000 aircraft, which means, you know, 4,000 engines that go into those.

Q Okay. All right. And then, finally, I want to ask you one last set of questions regarding composite technology. Polymeric composites, are they used in other products other than jet engines?

A Well, certainly, yeah. Composites, you know, are used for recreational sports. You know, your carbon shafts on your golf clubs, for example, are composite. There's a wide range of use of composites. The unique thing about aerospace composites are the rigor that goes behind the control process to make those products and to actually make

the raw material, if you will, of the carbon resin structures.

Q Are there universities and other research facilities that do testing on composites and publish the results?

A Certainly. It's well-known in academia that composites are -- you know, everybody wants to use composites, so there's a lot of academia research on composites, a lot of studies, a lot of, I'm going to say, component testing level that's done. Yes.

Q Are you familiar with something called the *Composites Material Handbook*?

A Yes. It's a -- it's an industry-lead handbook, if you will, which tries to capture a best practice of very high-level design approaches. In other words, the pyramid that we showed on the first page was essentially from that handbook. We are, GE Aviation is, a participant in the material handbook for composites as well as our competitors, Rolls Royce and Pratt & Whitney. And there's academia also involved in that handbook structure or content.

Q So to a degree, there is shared information about composites, generally?

A Oh, certainly, yes.

Q All right. And the analytical tools that you use, I think you mentioned at trial there's a software called LS-Dyna?

A Um-hmm.

Q Are those publicly available to others?

A Yes, yeah. Certainly, industry tools such as LS-Dyna, Ansys, you know, finite element codes, that is open to basically worldwide, you know, that is supported worldwide at a commercial level. So anybody can buy that, whether it's any other country or any university. Certainly, it's available.

The key thing there is, you know, a lot of that I'm going to call -- it is what I call open architecture. So it may have the framework of analytical predictions, how -- how you -- the input is -- or the output is only as good as the input. So how well you understand the input makes your predictions and your success, if you will, very dependent on that.

Q All right. Now, I take it, within GE's files, within your fan module mechanical design team files, you have information and processes that are not made public; is that fair to say?

A Oh, yeah, certainly.

Q All right. Can you describe what it is in general terms, sort of the difference between what's publicly known about composites versus the value that GE has from its own internal information?

A Yeah. So I think it's certainly the characterization

level of understanding material. We talked about these analytical codes and the input that goes into those codes, the constants, they call them material constants. These codes, such as LS-Dyna, basically are basically mathematical tools to predict an outcome. All right. So I can model -- if you want to call it modeling, I can model an architecture, I can model kinetic energies and how the material might respond to that kinetic energy impulse, and that's all done mathematically.

But really to support those mathematical predictions are what I call constants, the input into that material modeling and some of the composites because it is directionally dependent, it's not like metal, isotropic, composites are orthotropic, so it's directional dependent. So instead of one direction applying to everything, it is biased in architecture and may be stronger in one direction versus another. To understand all of that and put those -- and understand those constants or derive those constants to put into that predictive tool is kind of the key. All right. So that's one thing.

And then the other thing is the path. Again, we talked to get from Point A to Point B. You know, from my -- basically, my conception of I want a composite part to actually certifying that composite part, what is the testing that you have to go through, what is the right process of,

okay, as I build myself up that pyramid, how do I -- how do I choose the right test at the right time, to down-select I have confidence in so I don't have to fall back and start over again, that's the key.

Q All right. I take it, over your period of time in working in this field with GE Aviation, you've seen developments of fan modules where you've made mistakes, you've had learnings, you've had some trial and error; is that fair to say?

A Yeah. I think in any design process, it's -- that's the beauty of engineering, a lot of it is trial and error, and there's multiple ways to skin a cat; but to be the most efficient is really the key that's going to give you that competitive advantage, getting to the market first, making a product that's durable and meets all of the criteria of federal regulations.

MR. MANGAN: All right. That's all I have.

MS. GLATFELTER: One moment, Your Honor.

MR. MANGAN: One moment, Your Honor.

THE COURT: Very well.

(Pause.)

Q If we could go back to the GE9X.

A Yes.

Q Can you talk through -- I know this case kind of came about in 2017; was that still under development at that

time?

A Yes. Actually, the GE9X from an engine perspective was certified in 2020. The aircraft I believe has been certified, maybe. The Boeing aircraft, which is the triple 7 9X, has not been delivered to customers yet. It is flying. It has GE9X engines on it, but the actual engine from an FAA perspective has been certified in 2020.

Q All right. And so when was it first put on a plane?

A I think 2021 is when they start doing first flights on a triple 7. Now, that being said, we have a flying -- what we call a flying test bed, which GE owns. It's a 747 aircraft where we typically put our demonstrator engines on even before they're certified. So it did fly in probably 2019 on that demonstrator flying test bed, but, certainly, it could not carry passengers at the time. Just for development purposes.

Q So in 2017 when Mr. Xu was working on the GE9X, would you say you're towards the tail end of the development process?

A Yes, that would be correct.

Q Okay.

A I believe -- I think we were -- we hadn't done the containment cert test. We were probably -- on this chart, probably in that ten-year type of time frame mark.

Q All right. And then, I apologize, if we can go back

to the total that you have on page 1.

A Um-hmm.

Q I think we may have the wrong total that we've added up, so I want to go back and check the math for the Court.

A Okay.

MR. MANGAN: So apologize for just discovering this now, Your Honor.

THE COURT: I was doing it in my head. Go ahead.

Q If we add that up, is that -- it looks like that adds up to 98 million, not 107?

A Okay.

Q Do you see that?

A I can't do it in my head here, but probably true.

Q All right.

A It seems like a big number you say, whether it's 98 or a hundred, but when you go back to the 94B engine, which was the first engine we developed for composites, that overall engine cost was $2 billion, and that's in open literature of what our cost was.

Q Was this -- was this reflecting sort of the most current ability as you estimate it that GE could do in terms of developing an engine and just the fan module part of that engine?

A Yeah. I mean, the people we had working, the seven people here, we talk about a fan module team, they are

experienced engineers who had worked with composites before, were familiar with the process. We have design process templates internally in GE that guide us through that process to get there most efficiently. So this was not a -- was not, you know, inexperienced engineers. These were people that were familiar with this.

MR. MANGAN: All right. That's all I have, Your Honor. Thank you.

THE COURT: Very well. Witness has been on the stand for almost an hour. We're accommodating interpreters. Always like to ask this: Counsel, how long do you anticipate your cross will be?

MR. MIEDEL: I would expect about half an hour or 45 minutes.

THE COURT: I think at everyone's deference, we should take a break at this point. You can sharpen your tools. I would like to take a tight 10 minutes. The Internet says it's 11:32. I would like us all back and ready to proceed at 11:42. We'll take a short break. Please do not discuss your testimony.

THE DEPUTY: All rise. This court is in recess until 11:42.

(Recess taken from 11:32 a.m. to 11:42 a.m.)

THE DEPUTY: All rise. This court is back in session pursuant to the recess.

THE COURT: Thank you. Please be seated. The witness may retake the stand, and he remains under oath. And he understands, correct?

THE WITNESS: Correct.

THE COURT: Very well. Cross-examination.

MR. MIEDEL: Thank you, Your Honor.

THE COURT: Brace yourself.

MR. MIEDEL: Good morning, Mr. Kray.

THE WITNESS: Good morning.

MR. MANGAN: My name is Florian Miedel. I'm one of the attorneys for Mr. Xu.

THE COURT: He's from New York.

MR. MIEDEL: I hope you don't hold that against me, Mr. Kray.

CROSS-EXAMINATION

BY MR. MIEDEL:

Q Let's start out really simple. As you understand it, this case involves the attempted theft of trade secrets from GE Aviation, correct?

A Correct, yes.

Q Specifically relating to fan blades and encasements made of composite materials, right?

A Correct.

Q Okay. And you testified at the trial, as we know, correct?

A Correct.

Q Now, at the trial, you testified that if someone was successful in obtaining some of GE Aviation's trade secrets, that could affect GE's competitive advantage down the road, right?

A That's correct.

Q And you said that because, as you mentioned today too, GE currently enjoys a significant competitive advantage, right?

A That is correct.

Q Because right now it's the only manufacturer of composite fan blades and encasements that has it on engines that are in the air, right, that are certified?

A Correct.

Q So essentially, GE has a monopoly, right, on this product?

A I would say we have the right technology at the time.

Q Okay. Now, if some competitor obtained GE secrets in this process and as a result could build an engine using composite materials a little bit faster, that might lead to a reduction of GE's market share down the road, correct?

A I think it would prove to be competition down the road. Sure.

Q It would what?

A Prove to be competition down the road. Yes.

Q Right. And if there is competition, presumably, there would be some loss of market share to GE, correct?

A Potentially, sure.

Q Now, just to be clear, obviously, if someone steals some of GE's proprietary information in this area, that doesn't prevent GE from continuing to make -- design, make, sell, fan blades and encasements, right?

A That's correct.

Q GE doesn't lose the ability to develop, make, market, and sell those products?

A I think the key thing is that we're always trying to go the next step in efficiency, so having that process that you can leverage up onto next engine design is key. Yes, we would certainly --

Q I understand. And GE would continue to do that?

A Certainly.

Q Continue to work in this area, right?

A Certainly.

Q Regardless of whether or not someone had obtained trade secrets or not from GE?

A I think it wouldn't -- it wouldn't affect my day-to-day effort, no.

Q Okay. And so any potential loss to GE Aviation when a trade secret is stolen isn't immediate; it might be in the future, correct?

A It would be -- certainly, the design cycle, you know, if you lost technology today, to actually see it show up in the field might be five or ten years, right. So yeah, it wouldn't happen tomorrow, but it would happen down the road, yes.

Q Right. So, for example, if someone steals something tangible, like let's say your 1963 Corvette Stingray that you've lovingly restored, one, you would want the car back, right?

A Correct.

Q And if the car is lost, you'd want the thief to pay what the car was worth, including the time that you spent working on it, right, ideally?

A I think in that case, you're correct.

Q Okay. Here, we're talking about something totally different, right, this is -- GE has not lost a product, it hasn't lost its knowledge, its know-how, its expertise, its skills to make these products, right?

A I think it loses its competitive advantage at some point.

Q At some point, right?

A (Nodding head.)

Q Okay, sure. Now, a future reduction or loss of competitive advantage, that depends on a number of different factors; do you agree?

A Oh, yeah, certainly.

Q That can depend on how fast, for example, a competitor can research, develop, and build their own technology, right?

A Certainly.

Q It depends on how far along a competitor might already be in the process at the time when they acquire the trade secret, right?

A That's true.

Q It obviously depends on what the actual trade secret is; some trade secrets may be of great use and some might not, right?

A I would say yes; but, you know, if it's considered a trade secret, we have deemed it to be very important internally in our GE Aviation.

Q Well, sure. That's information that you don't want out there, certain test results, for example, right?

A Right.

Q But we'll talk about this more, but some test results may be of little use to a competitor who's already had their own testing done, right?

A Potentially, sure.

Q Okay. So you would agree, right, that sitting here today calculating what such a future potential loss to a competitive advantage or market share -- calculating a

number would be really difficult, right?

A I would say the number would only go up. Right.

Q Well, but you can't, you can't put a number on that right now because of all of these variables that we talked about; isn't that right?

A Okay. Another way to look at it, sure.

Q Okay. Okay. Let's -- let me ask you some questions about the Building Block method that you already discussed.

General Electric Aviation in manufacturing these products uses the Building Block method, correct?

A That's correct.

Q And the Building Block method is an approach, a method of how -- of how to build something, correct?

A It's a philosophy more so than a method.

Q Okay.

A And it's really very logical. It doesn't take much thought behind it to say that you don't start with the final product, I start from a very basic understanding as I work up to more and more complex issues.

Q Right. You start very small?

A Um-hmm.

Q You test, you analyze, you make it bigger, you test, you analyze, so on, you move up the chain?

A Right.

Q And would it be fair to say that the Building Block

method is the method that's used by everyone who builds jet engines?

A I would say it's probably used by anybody who makes anything. You know, *Composite Material Handbook 17*, which the Building Block comes from, is not specific to turbine fan engines. It's used for aircraft structures as well, so it's not specific to engines.

Q Right. But you're not aware of anyone -- any manufacturer of jet engines, specifically, who uses any method other than the Building Block method, right?

A I would agree. Again, you know, GE is a member of the CMH 17 Handbook committee, if you will, as well as our competitors. So yes.

Q Got it. Now, the Building Block method is the philosophy that is sort of an overarching approach to building something, but how something is built depends on a lot of different factors, correct?

A Certainly.

Q It depends on the materials that are being used, right?

A Correct.

Q It depends on what architecture you decide to make the composite, whether it's braided, woven, laminated, right?

A Correct.

Q It depends on what prior knowledge you might have

institutionally that you can apply to the process, right?

A I think, I think you base it upon learning, sure. I mean, what you learn from experience base, whether it's previous programs or your own testing, you learn what works and what doesn't work, yes.

Q Okay. It also depends on the specific manufacturing methods that you use, correct?

A Correct.

Q And that includes also the tools and the machines that you use?

A Exactly.

Q All right. So with that background, let's look at this chart in Exhibit A.

A Um-hmm.

Q Government's Exhibit A. And I want to direct your attention to the right diagram, the blue chart, and actually go to the bottom of that. And you discussed some of this on direct, but I just wanted to follow up on that.

The bottom arrow, so to speak, is the containment certification test, correct?

A Correct.

Q And as you said, before an engine is allowed to fly on an airplane, it has to be certified; in the United States, it has to be certified by the FAA, right?

A Before it's allowed to fly, I'm going to call it, in

revenue service, before it's allowed to carry passengers.

Q Carry passengers?

A Yeah.

Q Sure. And there are similar agencies to the FAA in other countries, correct?

A Oh, yeah, certainly.

Q And, in fact, the FAA has agreements or treatises or whatever they're called between -- with other agencies to ensure consistency, correct?

A Yeah. I mean, one that comes to mind is EASA, which is the European agencies, and they try to harmonize their approaches to certification.

Q Okay.

A Yes.

Q And you discussed this. In order to certify an engine, the FAA requires a full engine blade-out test, correct?

A That is one of the requirements, yes.

Q All right.

A That is not the only requirement, but that is one of the requirements.

Q Understood, yes. And that means, as you said, you have to build an entire engine, right?

A (Nodding head.)

Q That means the front section, the fan blade section,

the other parts, the hot section, as they're called, right, everything, right?

A Yeah. And that engine has to be conformed. When I say conformity, it has to be the exact architecture that you plan to submit for certification. So even though the fan module is basically a fan test, the turbine discs, for example, have to be the exact disc architecture, material, geometry. It has to be signed off by an FAA person to say, yes, that conforms to your design and what you're testing actually represents what will be flying to the public.

Q Okay. And then the engine basically gets destroyed, right?

A That is correct.

Q So that's why, among other reasons, this test is very expensive, right?

A Um-hmm.

Q And by the time you get to it, you want to make sure you've done everything else right, correct?

A You want to go into that test with as high confidence as possible because not only is that test expensive, but it's also visible to the agencies. In other words, you don't want to go to the agencies and have a test failure, because not only do you lose confidence in your agencies because you're trying to test something that didn't pass, but you also -- you know, there's a lot more scrutiny then

behind those test results.

Q Of course.

A Yeah.

Q And any competitor of GE Aviation's who builds a jet engine would have to go through this certification process, correct?

A Yes.

Q And that's whether or not they built that engine using, let's say, GE's proprietary information, right?

A I would say any engine that gets built has to be certified to those rules.

Q Right. And my question is, even if that engine uses some trade secrets of GE's to be built --

A It would still have to be certified, sure.

Q -- it would still have to be certified, right?

A Yeah.

Q And GE has to have that engine certified whether or not some of its trade secrets were stolen, right?

A That's the only way to sell it to the customer. Yes.

Q Right. In other words, the cost of the certification test has to be born by GE whether or not there was a trade secret theft, correct?

A I think to get it -- to get a product to the public, yes, it has to be certified.

Q Okay. And in this chart, the certification

containment test is $50 million, right?

A Correct.

Q Out of the total of $98 million?

A Correct.

Q Okay. Now moving down the chart to the containment rig testing.

A Um-hmm.

Q You described that as a series of tests where you built essentially the front section of the engine and you put it through testing, right?

A That's correct. We put it through a -- basically, a simulated blade-out test. It's driven by -- not driven by an engine at this point. It's driven by an electric motor to get the right RPM into the fan module, and then the release is executed, and the containment and the other dynamics of the engine is understood.

Q Okay. By the way, at what stage do you do the bird strike test?

A That's probably -- I would put that into subcomponent testing.

Q All right. So going back to the rig testing, that test or those series of tests are also very expensive because you do have to build the entire module and put it through these tests, right?

A Yeah. So the containment rig testing is really just

the case, the discs -- the disc, one disc, the fan disc and the blades.

Q Right. And any competitor who builds a jet engine using composite materials has to also go through the containment rig testing, right?

A Well, again, you don't have to. It's an engineering test, so it's not required. It's not required by any agencies. It's something we do in-house because of the confidence-building and the understanding, getting an understanding, but it is not a requirement.

Q Right. But if you skip that test -- if you skip those tests, that could lead to all kinds of problems, right?

A Well, it could lead to, again, a surprise in your certification test, which is -- you know, that's much more costly.

Q Right. And nobody wants a surprise in the certification test?

A Exactly.

Q Because it's so expensive?

A Exactly.

Q So it would make sense -- even if it's not required by the FAA, for example, it would make sense that anyone who builds an engine like this would go through that kind of testing to get to that stage, correct?

A It would be very cavalier not to.

Q Right. And then below that, we're talking about the subcomponent testing?

A Um-hmm.

Q And, again, testing is really a primary feature of the Building Block approach, right; you're constantly testing things, whether in -- you know, using the actual materials or using computer models, right?

A Correct.

Q And, again, although it's not -- there isn't any specific requirement by the FAA or some other agency like that, presumably, as you said, it would be cavalier to skip tests along the way because, for one, you would compromise safety, correct?

A Correct.

Q And you might not succeed in your certification test?

A Right, which would affect your overall schedule.

Q Right. And so anyone, whether they obtained -- whether they built the engine completely on their own or they used some proprietary material of somebody else's, would have to go through that testing, correct?

A I think that would be up to the individual company. Certainly, the required testing is certification. How you would feel -- again, cavalier -- in skipping some tests would be up to that individual company.

Q Okay. All right. Now, let's skip down to the first

arrow, the material property data and down-select arrow.

A Um-hmm.

Q That's a very beginning of this process, correct?

A That's correct.

Q And, in fact, the very beginning of the process is selection of the fibers that you're going to use, right?

A Fiber and resin system.

Q Right. So a composite is a very -- basically made up of carbon fibers and then a resin and sort of mixed together, right?

A Correct.

Q Now, the choice of what fiber you use, that can affect the entire design cycle, correct?

A That is true. The general use here is what we call intermediate modulus fiber, IM, intermediate modulus, which is a specific modulus range of carbon fiber, which is in industry called intermediate modulus. So there's lots of suppliers of it, but it's typically intermediate modulus fiber.

Q Right. But I think -- and I believe you testified to this at trial, and I could refresh your recollection about it -- is that the fiber that is selected, that can control the entire design cycle in the sense that if you pick one fiber versus another fiber, they can have different results?

A That's true.

Q Okay. So in other words, right, if you, GE Aviation, get your fibers from Fiber Manufacturer A and a competitor gets their fibers from Fiber Manufacturer B, that there could be significant differences in the way that the design occurs later on?

A Well, typically, we control our fiber by internal specifications, which include the modulus. We don't specify by manufacturer. So even though we use a single manufacturer, typically, we start out with that we don't deviate, that fiber specification could be met by other suppliers.

Q Okay. But the -- but you use a commercial vendor to sell you the fiber, correct?

A Could you repeat the question?

Q You use a commercial vendor, a supplier essentially, manufacturer?

A Yeah. We don't make composite fiber and/or resin.

Q And it's your understanding that carbon fibers are export controlled, correct?

A The fiber itself is, yes.

Q Okay. Which means that a country such as China could not buy its fiber from the same manufacturer that you get it from, correct?

A That is true. That's covered under the Department of Commerce.

Q Yeah.

A C010.b, I believe it is, which covers composite material.

Q Right. So, again, China could not buy its fibers from the same manufacturer as you buy your fibers from?

A The raw fiber itself, yes.

Q Right. And, again, different fibers could have impact on the design cycle down the road?

A Again, we specify it by fiber specifications, so whether it's made by Vendor A or Vendor B, if it meets the specifications, it could be used to meet that design.

Q Okay. There are also variations or differences in the resin, correct?

A Yes. Resins are -- you know, there's a whole host of different resins. They are not export controlled, at least the polymeric epoxy resins are not, so yes.

Q Okay. Then, of course, the way that they are -- the architecture of the design, whether you braid these materials together or you weave them or whatever, obviously, that decision can ultimately lead to a very different result in design?

A Certainly, and that's part of this first bar here, is the material down-select. It's not just the material itself, it's the architecture that goes behind it as well.

Q Okay. Now, if, if a competitor wished to

hypothetically replicate General Electric Aviation's process, they would have to know exactly the fiber that was used, right?

A They would have to know the specifications of the fiber.

Q The specifications of the fiber?

A Um-hmm.

Q They would have to know the resin and have the same resin, right?

A Correct.

Q They would know exactly what tests were conducted and what the tolerances are that you evaluate them at, right?

A Correct.

Q Okay.

A And you did mention that fiber is export controlled, that is true; but, you know, when we talked about composite material, you know, there's raw fiber and then what we call prepreg, right, which has resin already impregnated into the fiber, that is not export controlled for epoxies.

Q Does GE Aviation use prepregs?

A Yes, for composite fan blades, yeah.

Q All right. So I was asking you if somebody else was seeking to replicate GE in this process, right, and you said the materials would have to be the same, the testing would have to be the same, right; the manufacturing method would

have to be the same, correct?

A I would say that certainly manufacturing process would have to be the same, right, because it makes the end product and that's dependent on how you process it. The testing would not necessarily have to be the same. It would be -- again, if you had that commercial advantage, you might be able to skip that testing phase.

Q Okay. I'm sorry. If you had the commercial advantage like GE does?

A Right.

Q Because you already have --

A If you had the knowledge base.

Q Already gone through it?

A That's right.

Q You would have to have a production line that was essentially set up identically, correct, to have the same product at the end?

A I would say not identical, but it would have to do the same processing, yes.

Q Okay. And if a competitor were not to have all of those essentially same or identical processes, materials, that sort of thing, tools, they would have to go through this process on their own, wouldn't they?

A That's correct.

Q Okay. Mr. Kray, you testified that a commercial jet

engine consists of multiple parts, correct?

A Correct.

Q There are different modules?

A Correct.

Q And so there are different teams of engineers that work on different parts of the engine, right?

A That's correct.

Q In other words, one engineer wouldn't work both on the fan section and the turbine section, right?

A That would be very, very unusual, unless -- we have what we call system engineers, which are more of an overarching integration, if you will, you know, how well the air comes from the fan through the turbines, et cetera, they would have exposure to that complete engine level.

Q But, generally, these different parts of the engine require different skill sets?

A I would say, yes, true.

Q And at General Electric, engineers who work on one part of an engine, they don't generally have access to the information or data or proprietary information that govern other parts of the engine; is that correct?

A I would say at the module level, yes, that's true.

Q Okay.

A In other words, fan module typically wouldn't have to deal with technologies of a turbine module.

Q It's compartmentalized and it's sort of a need-to-know kind of situation, correct?

A That's true, that's true.

Q Now, Mr. Zheng, he worked, as you said, on the module, in that seven-person module on the fan blade encasements, right?

A That's correct.

Q He specifically worked on just encasements; he didn't work on fan blades, right?

A That's correct.

Q And, by the way, on direct you mentioned the directory that you saw of the computer files, right?

A Yes, correct.

Q And those computer files on that directory, first of all, those were not actual computer files, they were created by the FBI, right?

A I'm not aware of that.

Q Okay.

A All I know was that it was the directories that were represented and that it was BC.

Q But what you saw in the directory concerned that specific module, right, that Mr. Zheng was working in?

A I don't know any otherwise.

Q You don't know otherwise?

A I just saw what I saw and that's all.

Q That's fine, that's fine.

And, Mr. Zheng, he worked on the containment casing for the GE9X engine, right?

A Yes, but as I mentioned in trial, Mr. Zheng, Daihua, you know, prior to working on the 9X containment case worked at our GE Niskayuna facility, our global research facility, and in that capacity, he worked on our GEnx engines and case containment technologies as well. So, again, he was -- we talked about the seasoned engineers of the 17, and he was very seasoned in that approach.

Q But when he was here in Ohio working at the plant here, he was working on the GE9X, right?

A That's correct.

Q The GE9X, that's a big engine, correct?

A Yes.

Q It goes on big planes?

A Goes on a triple 7 9X, which is the biggest, biggest twin engine that will be flying here soon.

Q And it's the only -- the triple 7, that's made by Boeing, right?

A That's correct.

Q The triple 7 is the only airplane that that engine is designed for, right?

A As of today, that's true.

Q Okay. And you testified on direct, I think that you

said that an engine is specifically tailored to a particular plane, right?

A That's correct.

Q And so in this case, the 9X is specifically tailored to the 777, right?

A That is correct.

Q Okay. Now, you're aware that currently China has just one home-built commercial aircraft, and that's the C919, right?

A That is correct, yes.

Q And that's not a large plane, that's a --

A It's like a medium, like a 737 type size.

Q Right. In fact, China has not yet built a wide-body, large airplane itself, right?

A That is correct, as far as I know, yes.

Q Okay. And the C919, the plane that China currently has, that's fitted with a LEAP engine, right?

A That is correct. That is a GE slash Safran product that we offer.

Q Right. And Mr. Zheng did not work on the LEAD engine, right?

A Not that I know of, no.

Q Okay. And, obviously, I mean this goes without saying, but the 919 could not be fitted with a GE9X, too big?

A Yeah, yeah, yes.

Q Okay.

A And, you know, in the technology as -- a composite technology in the LEAP engine is different than the technology in a 9X engine composite technology.

Q It's different?

A It's different.

Q You can't interchange the two?

A Yeah. The architecture and actually the carbon itself is different.

Q Got it. You testified -- moving on, just looking at this last page here, the customer value page.

A Um-hmm.

Q You testified that: GE engines with composite materials will likely save the customer about $1.55 million per plane over the life of the plane, right?

A That's correct.

Q Now, your customer, GE's customer, is the aircraft manufacturer, right?

A Well, a lot of times the aircraft manufacturer, whether it be Boeing or Airbus, sells an airplane to an airline.

Q Of course.

A And the airlines a lot of times have the liberty to choose an engine, whether it's GE, Pratt & Whitney or Rolls

Royce. Take the 787, for example, we compete with both of those competitors to engine that aircraft. So Boeing will offer the aircraft frame, and then the customer will make the engine selection.

Q Okay. Would you agree, though, Mr. Kray, that the $1.5 million figure that you have here for future customer value, that depends on a number of variables, right?

A Well, this 1.5 is just based on cost of operation due to the weight reduction of composites.

Q Right. But, I mean, whether the customer saves that $1.5 million per plane depends on a number of factors, right?

For example, it depends on whether GE remains the sole manufacturer of composites, right, because if they put on a different -- if they put on a jet engine made by a competitor with composite materials, then, GE wouldn't -- that wouldn't be a benefit to GE, right?

A It would -- it gives us our competitive advantage. I mean, so our asking price for an engine may be different from a competitor. At that point, it's up to the customer to say whether I save the money today and buy a cheaper engine which may not be as efficient or I buy the GE engine which I pay a premium for and I make my savings in long-term.

Q Right, right, and I was going to ask you that

actually. I mean, if you are saving $1.5 million per plane by using an engine made by GE with composites -- let's say I'm an airline and I decide, you know what, but I can buy an engine that's $10 million cheaper than GE's engine, you know, the savings maybe don't matter to me that much, right?

A That is the business plan of the customer, the customer airline, of which way they want to go. Certainly, you know, with fuel costs as volatile as they have been, I think it's become more and more important that the customer looks at the operating cost versus the -- I'm going to call it the cheap road, if you will, of a cheaper engine that's not as efficient.

Q Understood. It also obviously depends on the number of planes that are fitted with these engines, right?

A Certainly, all depends on the business plan of the customer.

Q And it depends on how far along China is in building their own composite materials, right?

A Potentially.

Q You say it's over the life of an airplane, which is 35 years, but if China catches up within 5 years and puts their own engines on their planes, then, you wouldn't have a 35-year time period, right?

A Right. But, remember, we're always trying to advance the technology, so what is new today will be old in five

years and we'll be on to the next iteration, if you will, of composite technologies. I mean, that's our -- kind of our business plan, is to lead with technology, so we're always pushing for more complex systems, better architectures, you know, better products to keep this type of business advantage.

Q Right. But when you're trying to calculate a number of what -- what loss GE might suffer by not being able to sell its engines down the road, right, that number is far ahead in the future because sitting here today, as you said earlier, you can't really calculate that number, right?

A A way to look at it, sure.

Q Okay. I'm almost done, Mr. Kray. Just a couple more questions.

The development, manufacture, testing of composite fan blades and encasements is an extremely complicated process; you would agree with that, right?

A I would agree, yes.

Q This is a highly engineered product, right?

A Yes. It's highly sought-after by the customer as well.

Q Right. But my question is: It's a highly engineered product, right?

A It is.

Q And you would agree, right, that no competitor could

steal some proprietary information, let's say something about some design or some test result or how strong certain materials are, and then be able based just on that to replicate a GE entire process, right?

A I think it would give them a leg up. It would give them a jump start, if you will, in the process; but, certainly, they would have to go through their own magnitude of testing, certainly.

Q Right. You said it might give them a leg up, so to speak?

A Um-hmm.

Q But you don't know how high that leg is, right, you have no way of knowing?

A That's true.

Q And if anyone takes shortcuts in the building of an aircraft engine, they risk not getting -- getting through certification, right?

A That's true.

Q They risk their product failing, right?

A True.

Q And how high that leg up is or how -- you know, how -- how fast or how much faster this timeline might be also depends on a number of factors, right, for example, how long they already are in the process, how far along they are in the process, right?

A Yeah. As I mentioned, you know, the timeline that we had laid out for the 9X was, and that's a timeline based on, you know, the exact program --

Q I understand.

A -- itself, but that was with seasoned engineers who knew the process, who were familiar with it, who built upon the previous architectures of the previous programs of composite blades and cases. So that is a pretty aggressive timeline, but without that, it would be much longer.

Q But that's GE's timeline. GE's timeline would be completely unaffected by whether somebody took some proprietary information from GE, right?

A It wouldn't affect our timeline.

Q It wouldn't affect your timeline?

A That's right.

Q Whether it's a long timeline or a short timeline, it really doesn't matter for these purposes, right?

A That's right.

Q So just going back to where I started, and I'll end there, you agree that -- you know, you've said this -- that the theft of a trade secret could have the potential to affect GE's competitive advantage down the road, right?

A That's correct.

Q That's the potential loss that GE could suffer, right?

A That's correct.

Q It's not the money that GE spent to research, develop, build, test, certify an engine with composite fan blades or encasements, correct?

A That is correct.

MR. MIEDEL: Thank you.

THE COURT: Redirect, if any.

REDIRECT EXAMINATION

BY MR. MANGAN:

Q Just briefly, Mr. Kray. With respect to the laptop files that you were asked to look at, there's a directory that was discussed. Did you actually look at the laptop itself and be able to click into the physical files?

A Yes, yes.

Q And you did do that?

A Yes.

Q Okay. And so your testimony is based on you physically examining the electronic files?

A Not every file, but -- because there were a lot of files on there, but, yes, I did do quite a bit of poking around.

Q Those were related to which engine?

A GE9X.

Q And specifically the work on the fan module?

A That is correct.

Q All right. And were they specific to Mr. Zheng's work

in that area?

A That is correct.

MR. MANGAN: All right. Nothing else, Your Honor.

THE COURT: Very well. Recross on redirect?

MR. MIEDEL: No, Your Honor.

THE COURT: Very well. You appear to have survived, sir. Court releases you, you may leave if you choose. You may step down.

(Witness left the stand.)

THE COURT: And I want to talk to the lawyers about timing. It's about 12:20. I'm concerned about taking a lunch break given the tight parameters of time. And now I'll really put you on the spot, what's your estimation of the three witnesses from the defense timeline on direct?

MS. CORS: Your Honor, Jeanne Cors. We have two witnesses we're calling. Dr. Zheng will be relatively short and I would expect 30 to 45 minutes. Our second witness, Mr. Davidson, will go longer. I would expect it would be an appropriate time to take a lunch.

THE COURT: You tailed off at the end on the key question.

MS. CORS: Dr. Davidson I expect to go about as long as Dr. Kray. It may be shorter, but I would estimate about the same.

THE COURT: I have to get on an airplane at the end

of the day. I need to get there early to see what sort of fan blades are on it, so I want you to be cognizant of that. In terms of lunch, if you guys want to order lunch and then we take a short 15, 20-minute break when lunch has arrived, I would be willing to consider that. I think that's what we're going to do. But I'd like to just keep cranking.

Is the defense ready to call its first of two witnesses?

MS. CORS: Yes, Your Honor, we are.

THE COURT: This is the short witness?

MS. CORS: This is the short witness.

THE COURT: That will be a test.

MS. CORS: The only question I guess I would have, Your Honor, is whether the interpreter needs a break.

THE COURT: Do you need a break?

INTERPRETER HARMON: I'm okay, Your Honor.

THE COURT: As long as it's short, she's okay. That was a joke. Do what you need to do.

Ms. Cors, the gallery is leaving.

MS. CORS: I'm so insulted.

THE COURT: If the witness would be willing to approach, I'm going to put you over here.

(Witness took the stand.)

THE COURT: And if you could pause where you are. You speak English?

THE WITNESS: Yes.

THE COURT: I'm going to ask you to swear to tell the truth. Raise your right hand. Do you solemnly swear that the testimony you're going to give today is the truth subject to the penalty of perjury?

THE WITNESS: Yes.

THE COURT: Is that a yes?

THE WITNESS: Yes.

THE COURT: You may have a seat. Seat tips back. Stay close to the microphone. Thank you.

MS. CORS: Thank you, Your Honor.

THE COURT: You may proceed.

MS. CORS: Good afternoon, Mr. Zheng. I'm Jeanne Cors. I'm one of the attorneys for Mr. Xu.

THE WITNESS: Good afternoon.

DAVID ZHENG

of lawful age, Witness herein, testified as follows:

DIRECT EXAMINATION

BY MS. CORS:

Q Would you please state your name for the record?

A First name is D-A-V-I-D, last name Z-H-E-N-G.

Q Thank you. And, Mr. Zheng, you testified at trial in this matter, correct?

A That's correct.

Q And I'm going to try not to repeat questions from your

trial testimony questions that you were asked then. We're really going to focus on your time at GE and your job responsibilities, okay?

A Okay.

Q Where were you employed between 2012 and 2017?

A GE Aviation in Cincinnati.

Q Okay. And what was your job title during that time period?

A I was a lead engineer and then promoted to staff engineer.

Q And this was with GE Aircraft Engine Division, correct?

A That's correct.

Q And where did this position, staff design engineer, fall within the technical rankings at the division?

A So I was staff engineer. Above my level, there was technical lead, and then principle engineer. Above that, there would be chief engineer.

Q Okay. Did you supervise any engineers in your role?

A No.

Q Okay. And could you please describe to the Court your job responsibilities as a staff design engineer at GE Aircraft Division?

A I was responsible for design and manufacturing of the next generation composites, fan containment, and case for

the next generation aircraft engine.

Q Okay. And then was this for commercial jet engines?

A That's correct.

Q Did you work on any engines that were to be placed in military aircraft?

A No.

Q Did you have any type of security clearance from the Department of Defense or any other agency of the US government?

A No.

Q Okay. And we've heard testimony today that you have the fan encasement, but then the fan blades are housed within that encasement, correct?

A That's correct.

Q And as part of your job responsibilities, were you involved in the design of the fan blades themselves?

A I was not involved in the design, manufacture, of the fan blades, but I have limited access to the information in order to perform my job.

Q And we've heard the phrase "need-to-know access"; is that the type of access you had for your job at GE Aviation?

A That is correct.

Q And can you explain just practically what that would mean in terms of the information you would have access to and what you might not have access to?

A May I use an example?

Q Of course.

A If I say -- if I want to design, if I need to design certain components of the fan casing component, I would have to request approval from certain technical ranking in the company to get access to the design specification and design practices.

Q Okay. So you didn't have automatic access?

A No.

Q You would have had to have asked for approval to obtain access to those materials?

A That's correct.

Q Okay. And did your ranking, the fact that you were a staff engineer, have any impact on what information you may have access to with respect to fan encasements and fan blades?

A Yes.

Q Would it limit your access as well to the information that you might need to know for your job responsibilities?

A That is correct.

Q Okay. I'd like to take you back to the events of 2017, and I believe you testified to this at trial, but is it correct that the first reach-out you received from someone in China was through LinkedIn?

A That is correct.

Q And at the time, did your LinkedIn profile describe the position you held at GE?

A Yes, briefly.

Q Okay. Did it include any description of your job responsibilities?

A Yes, briefly.

Q Okay. And then you -- as you testified, you went to China and you made a presentation, correct?

A That's correct.

Q And did you meet with individuals from China, including Mr. Xu, outside of the context of that presentation?

A Can you repeat your question, please?

Q Did you have some social engagements while you were in China as well, dinners, lunches, anything like that?

A Yes.

Q Okay. And in your conversations with the individuals in China, did you talk generally about the position you held at GE?

A Yes.

Q And did you talk generally about the type of work you did, not getting into specifics, but generally the type of work that you did at GE?

A That's correct.

MS. CORS: A minute, Your Honor?

THE COURT: Yes.

(Pause.)

Q Mr. Zheng, do you still currently work in the aviation industry?

A No.

Q And do you still do any work for GE Aviation?

A No.

MS. CORS: Thank you.

THE WITNESS: Thank you.

MS. GLATFELTER: May I inquire, Your Honor?

THE COURT: I'm just gathering my strength. Did you conclude with your examination?

MS. CORS: I have.

THE COURT: Very well. Yes, government may inquire.

MS. CORS: I took your directive to heart, Your Honor.

MS. GLATFELTER: Good afternoon, Dr. Zheng.

THE WITNESS: Good afternoon.

CROSS-EXAMINATION

BY MS. GLATFELTER:

Q And you said before that you testified during trial in this matter, right?

A Yes.

Q And your testimony was true and correct, to the best

of your knowledge, right?

A Yes.

Q Okay. Your expertise at GE Aviation was in composite materials and design; is that correct?

A That's correct.

Q And your Ph.D. dissertation pertained to composites?

A Yes.

Q Now, you were a GE Aviation employee -- well, a GE employee from 2007 to 2018?

A That's correct.

Q Right. The first five years, you worked for GE in New York on composite issues?

A Yes.

Q And in that capacity, did you have access to broader information about composite materials?

A Very limited.

Q But you had access to composite materials in that --

A Yes.

Q -- position?

A Yeah.

Q And that composite information related to other GE engines, correct?

A Yes.

Q Other models, like GEnX?

A That's correct.

Q All right. From 2012 to 2017, you worked in Evendale?

A Yes.

Q And that was at GE Aviation?

A That's correct.

Q In 2016, you were promoted to staff attorney (sic), right?

A Staff engineer, yes.

Q Okay. And in that -- for that promotion, you were working on the GE9X, correct?

A That's correct.

Q That's the -- that was the newest and latest model of the GE engine?

A That's correct.

Q And you were on a design team related to the GE9X, right?

A That's correct.

Q And that design team that you were on related to the fan module?

A That's correct.

Q Okay. And there were approximately seven people that you worked regularly with on that team?

A Yes.

Q And you would collaborate with those people?

A Yes.

Q Share information?

A Yeah.

Q And you would have access generally to what information you needed to perform your duties, right?

A That's correct.

Q And if you needed additional information, you could request it?

A Yes.

Q And as of 2017, when you traveled to China, the GE9X engine was still under development, correct?

A That is correct.

Q And that's what you were working on?

A Yeah.

Q Now, when you went to China, you were able to transfer some GE files to your personal computer?

A That's correct.

Q In fact, before your trip, you transferred five zipped GE Aviation files to your personal laptop, right?

A Yes, through my personal e-mail, yes.

Q All right. And one of those files had export control markings, right?

A That's correct.

Q And at one point on the trip to China, during your presentation, someone from the university placed a thumb drive -- or gave you a thumb drive to insert into your computer, right?

A That's correct.

Q And during the presentation, you were asked things that you didn't feel comfortable answering because it was too specific about GE proprietary information --

A That is correct.

Q -- is that correct?

MS. GLATFELTER: Okay. One moment, Your Honor.

THE COURT: Very well.

(Pause.)

MS. GLATFELTER: Those are all of my questions. Thank you, Your Honor.

THE COURT: Very well. Redirect, if any?

MS. CORS: Very short, Your Honor.

THE COURT: I believe you.

MS. CORS: One minute, Your Honor?

THE COURT: Yes.

(Pause.)

MS. CORS: Thank you, Your Honor.

THE COURT: Yes.

REDIRECT EXAMINATION

BY MS. CORS:

Q Now, Dr. Zheng, you were asked about your employment in New York for GE prior to your tenure at Evendale, correct?

A Can you repeat your question again?

Q You were just asked, correct, about the work that you did in New York prior to coming to Cincinnati and working for GE Aviation in Evendale, correct?

A That's correct.

Q Did you maintain access to all of the materials you had in New York when you switched jobs and came to Evendale?

A No.

Q And I take it that you did not maintain any type of confidential information from that job that you stored on a work-top or personal laptop during your tenure at GE Aviation in Evendale, correct?

A Yeah, not in a personal laptop.

Q Okay. Now, you were asked about some zip files that you had on your personal laptop when you visited China; you were just asked about that, correct?

A That's correct.

Q Did you ever share those zip files with anyone in China?

A No.

Q Okay. And during your communications with the individuals in China, did you inform them that you would not be able to share any confidential information of GE Aviation?

A Yes.

Q And did they ever ask you to share any confidential

information of GE Aviation at that time?

A They did not ask.

MS. CORS: Okay. One minute, Your Honor.

THE COURT: Very well.

(Pause.)

MS. CORS: No further questions.

THE COURT: Very well. Sir, thank you. You may step down. You're free to go.

THE WITNESS: Thank you.

THE COURT: I can release this witness from the government's perspective?

MR. MANGAN: Yes, Your Honor.

THE COURT: Defense as well?

MR. MIEDEL: Yes, Your Honor.

(Witness left the stand.)

THE COURT: All right. I think we should take a 30-minute lunch break. I hope you ordered lunch. It's 12:37, so at 1:07, I'd like everybody in the courtroom ready to proceed.

Is there anything that stands between us and adjourning at this time, from the government?

MR. MANGAN: No, Your Honor.

THE COURT: Defense?

MR. MIEDEL: No, Your Honor.

THE COURT: 30-minute break. Thank you.

THE DEPUTY: All rise. This court is now in recess for 30 minutes.

(Lunch recess taken from 12:37 p.m. to 1:11 p.m.)

THE COURT: Court is back in session. Counsel has arrived. Defense prepared to call a witness at this time?

MS. CORS: Your Honor, our interpreter, Mae Harmon, I think just stepped into the restroom, and she'll be back in a minute.

THE COURT: Very well. The Court will continue to wait.

(Off the record from 1:11 p.m. to 1:14 p.m.)

THE COURT: Second interpreter has arrived. We're in session. Defense prepared to call a witness at this time?

MS. CORS: Yes, Your Honor, we are. The defense calls Dr. Barry Davidson to the stand.

THE COURT: Doctor would be willing to approach. We're going to put you over on the witness stand.

(Witness took the stand.)

THE COURT: Good afternoon. If you would pause where you are, I'm going to ask you to take the oath to tell the truth. Will you raise your right hand? Do you solemnly swear or affirm that your testimony today will be the truth subject to the penalty of perjury?

THE WITNESS: I do.

THE COURT: Very well. You can step into the witness stand. In the spirit of full disclosure, the seat tips back.

THE WITNESS: Okay. Thank you.

THE COURT: Going to need you really close to that fancy microphone.

THE WITNESS: All right. I'll do my best.

THE COURT: Don't be messing with my screen.

THE WITNESS: Sorry about that. That's your screen? I was trying to get close. I do tend to talk fast, so do tend to slow me down.

THE COURT: I caution you not to speak too quickly.

THE WITNESS: Yeah, feel free.

THE COURT: All right. Now you may proceed, questions for the witness. Go ahead.

MS. CORS: Thank you, Your Honor.

BARRY D. DAVIDSON, Ph.D.,

of lawful age, Witness herein, testified as follows:

DIRECT EXAMINATION

BY MS. CORS:

Q Dr. Davidson, would you please state your name and spell it for the record?

A Barry D. Davidson, D-A-V-I-D-S-O-N.

Q And would you please describe your educational background?

A Certainly. I obtained my bachelor's degree summa cum laude in 1991 -- 1981 from State University of New York at Buffalo. I worked after my bachelor's degree. I went back to school at California Institute of Technology for my master's, which I obtained in I think May '93. And I worked after that and went back to school and got my Ph.D. at Texas A&M University. I should say my bachelor's was in aerospace engineering. My master's was in aeronautical engineering at Cal Tech, and my Ph.D. was in aerospace engineering from Texas A&M and that was in 1998.

Q And since you completed your education, what area of engineering in terms of aerospace or general engineering have you focused on?

A So immediately after my bachelor, I focused on -- actually, I was a designer on the Space Shuttle Orbiter, so did just kind of general spacecraft design. Since my master's degree, I've been essentially exclusively involved in composite materials, majority of which have been polymeric matrix composites.

Q And can you expound a little bit on your knowledge and experience with respect to polymeric composite materials?

THE COURT: Will you all keep your voice up for this old man, please, and don't trail off at the end?

MS. CORS: Yes, Your Honor. Sorry about that.

THE COURT: I was cautioning her, sir.

THE WITNESS: Is this okay?

THE COURT: Yes.

THE WITNESS: All right. So I guess experience is easier to address than knowledge. So experience, when I graduated from Cal Tech, I joined into and within three months took over control of Rockwell International Space Division's advanced composites program that was in their advanced engineering. I was responsible for supporting proposals on all new spacecraft, which involved composites, did space station.

I had internal research and development, a budget of 300K or so a year, which actually in 1983 was a lot of money, could do a lot with it. I had about three to five people working on me -- working for me. We also did application to Space Shuttle Orbiter and a number of other projects in terms of advancing Rockwell's state of knowledge with respect to composites. Subsequent to my -- went back from Rockwell for my Ph.D.

Subsequent to that, I ran the Jet Propulsion Lab's composites program. JPL does unmanned spacecraft. So at Rockwell, I was doing heavy-duty structure for manned spacecraft. JPL was a much lighter spacecraft structure. One of the biggest issues was impact damages when you're launching it and micro meteorite damage and things like that.

I went from JPL to Syracuse University where I spent 31 years. I developed and ran the Syracuse University Composite Materials Lab, SUCML, which became a world-renowned lab. Students came from all over the world to work with me and work in my lab. Certainly, as a professor, I taught courses in every aspect of structural analysis, composite materials, that you can imagine.

But a university professor actually kind of runs a small business, so really my job was mostly research. That is, my job was to bring in research money to the university. So I would go to the FAA, to NASA, to the Navy, to the Air Force, to the Army, National Science Foundation, identifying projects that were in need to be addressed for composite materials. I was -- I controlled $26 million in research funding over the years.

Our basic focus was on developing predictive models or models that could predict failure in composites under many, many different situations and verifying them by experiment. So my money would be used to buy equipment, buy supplies, pay my students' salaries. We would build structures, develop models, and we would show that we can actually predict failure. I published and places like GE and Boeing and others used my models to design structure. If they can predict failure, it won't -- you know, they can design it so it won't fail.

During that time, I did quite a bit of consulting. I teach short courses on design analysis composites. I teach short courses on damage tolerance composites, both generally at conferences and specific. I've taught courses for Sikorsky on design analysis and damage, composite rotor blades. Israel Aircraft Industries for damaged on jet aircraft composite fighters, and the issue there is in ways analogous to what's in this trial. That is, if you think about damaged fighters, a fighter jet gets battle damage, a rotor craft gets impact damage. The issue is the structure takes damage and it has to get home safely, and so you need to be able to predict the damage that occurs and predict how it grows and design the structure to withstand that.

So through this, I've really gained an expertise in all phases, design, analysis, testing, manufacturing, costing. People would say I'm -- you know, I'm internationally and nationally known. I've been asked and, you know, agreed to chair the world's largest conference on composite materials in 2016. My works are highly cited in the literature, which means that people use my work, that I'm not just publishing out there. I published -- I don't really keep track, 150 to 200 papers in the area of composite materials.

I decided to retire from Syracuse University a couple of years ago, and NASA heard about this, and so right now, I'm a NASA consultant. I run a large program on a

high-temperature composite developing a next-generation space plane, basically a hypersonic vehicle, does more than five times the speed of sound. High-temperature composites where we are -- do everything from the research level through the Building Block approach to the manufacturing, testing very large-scale structures.

Q And as part of your work, did you routinely review literature within the industry with respect to composites, peer-reviewed articles, other types of literature, publicly available information?

A Yeah, gosh, yeah. So first of all, I publish extensively, so part of publishing is you need to be completely aware of what's gone on before you because you're building on a body of knowledge, you're not just working in a vacuum. So any time you're doing a publication, you're doing a vast literature review on everything that's been done on that, and you're showing that you know expert -- that you have knowledge of that and how your work contributes to that and advances it.

I also work in a tremendously wide range of composite materials. So I'm constantly doing literature searches for -- you know, I might have ten students, so I know what my ten students are working on, and I usually know more about their projects than they do for my consulting jobs. I would conservatively estimate I've read 15,000 papers on

composite materials in the course of my career.

Q How about conferences and seminars, did you attend conferences and seminars as part of your work at Syracuse?

A Yes. Used to be regularly, you know, less regularly as I got more advanced in my career. I chaired conferences, and at conferences there's technical exchanges of two types. One is people give presentations obviously on their work, and you sit and you listen, you ask questions, you have technical interchanges. And then the second, of course, is in the hallways, at lunch, we all exchange information. You know, the academics, we talk about our issues.

We always -- academics will ask the people in industry, well, how are you doing this or how are you doing that because, one, we're just curious because we're engineers, but also that's how we make our livelihood, by addressing problems of pressing concern to industry because that's really what government does. They fund academics to solve those problems and fill the gaps.

Q Okay. I'd like to turn now to the Building Block approach, and specifically you were -- had the opportunity to listen to the government's witness, Mr. Kray, correct?

A Um-hmm.

Q And would you generally agree with Mr. Kray's testimony regarding the Building Block approach?

A Absolutely. I think he did a nice job of walking

through it.

Q Can you discuss from your perspective the role of the Building Block process in developing composite parts for aircraft engines?

A I would agree with Mr. Kray, it's really kind of the gold standard. It's the approach that people use. You know, it arose over a period of many years, but it is the approach used certainly in aerospace without exception.

Q And are you aware of any instance of a manufacturer manufacturing a composite part that wasn't developed -- for aircraft engines that wasn't developed through the Building Block approach?

A No. I guess I would echo Mr. Kray's answer, I would say not for any part of an aircraft not, say, since at least 1995 in either civilian or military application. No.

Q Are you familiar with an FAA Advisory Circular 20-107B?

A Composite Structures For Aircraft, I believe is the name of it. Yes, I'm familiar with it.

Q Correct. One that addresses the use of the Building Block approach in the design and development of composite components for aircraft?

A Correct.

Q And what does that advisory state regarding the Building Block approach?

A So I guess to move back or step back, so that advisory circulars are ways that the FAA communicates to aircraft manufacturers and other manufacturers how to -- really how to get your structure certified because, you know, they want you to come in and they want you to be ready.

So 20 dash 107B addresses composite structures. And so it says: How do you comply with FAA certification regulations for composite structures? And what it says, interestingly enough, is it says: You can use the Building Block approach or you can use an equivalent approach. But it doesn't give the equivalent approach, and it goes into extensive detail about how to get composite structure certified by the Building Block approach. So that's really come to mean and be interpreted by the community that you use the Building Block approach to certify composite structures.

Q Okay. Are you familiar with another document on the FAA website entitled *Implementation Procedures For Air Worthiness*?

A Yes, yeah, I am.

Q And can you describe for the Court what that document is?

A Yeah. That's actually an agreement with the FAA and the CAAC, the essentially FAA equivalent in China, China's aircraft certifying agency, and it's somewhat like Mr. Kray

talked about with the European agencies. It's that the FAA and CAAC have looked at each other's procedures, decided that they are essentially equivalent and said that if one certifying agency certifies a structure, it's equivalent to the other one. So Chinese aircraft are cleared to fly in American air space and vice versa, and, you know, they use the same processes.

Q And with respect to this bilateral agreement, does it touch on the Building Block process?

A So it's an overarching, so by implication, that means that the Chinese are going to use the Building Block approach for composites. And if you look through the Chinese literature where they -- you know, they publish their results the same way we do -- it's clear they use the Building Block approach in exactly the same way that we do.

Q So we've talked about the Building Block approach in general in Mr. Kray's testimony. But I would like to ask you why in your view is it so important for manufacturers to follow the Building Block approach in designing composite components for aircraft engines?

A That's a good question. So, you know, again, I wasn't at the trial, so I don't know how much this came up. But composites are incredibly complex, right. If you look at a metal, it looks the same, doesn't matter how you turn it over. As a matter of fact, if you look at it under a

microscope, it looks the same. It looks the same until you get down to the element, you know, the atomic level. And they have a few very simple failing modes, "simple" quote/unquote, but we don't really understand them.

If I can indulge you for a minute and talk about a composite. Some of this has been given. So let's talk about a laminated composite. Each layer or ply is composed of fiber and a resin or a matrix. And the matrix, it's a glue, it's an epoxy, okay, and it starts off soft and tacky; you put it on a part and it gets hard. Now, the fibers are -- I don't know, 5, 10,000th-inch diameter. So when you buy this material, it come in about sixteenths-of-an-inch thick and 20 fibers through the thickness.

So if I have all the fibers in the same direction, I make a part, and it's going to be very strong and stiff in the fiber direction, and in the other direction, it's going to be less strong. (Indicating.) Now, if I pull it to failure in the fiber direction, chances are I'm going to pull it, pull it, and fibers are going to snap, so I get fibers to fail. If I pull it in the other direction, I'm going to get cracks in the matrix, and so the matrix can fail. Okay. If I shear it, like this, well, the matrix is going to fail, but it's going to fail differently. Think about it, it's almost like it's a shear fail. It's almost like pulling Silly Putty. It doesn't crack, it just kind of

shears along. Right.

If I push on the fibers, they're going to kink, the individual fibers, they're going to kink out. These are all dramatically different modes, right, and this is just one ply. As a matter of fact, I have some materials, if I push at them, none of these things will happen; the fibers will debond from the matrix. The bond between the fiber and the glue will break. I start stacking plies, put one at 0, one at 90, one at 45, one at minus 45, and another failure mode is delamination, they pull apart.

Now, when composites fail, they don't fail by one of these, they cascade. So I have this complex part, and the kinds of things that Mr. Kray deals with this stuff all of the time, I'm sure. I start loading it up, I get a split in one ply, a crack, matrix crack, and a matrix crack in another, and a shear failure, and they interact, and they cause a delamination, and fibers start breaking, and it's a whole cascading and incredibly complex process. And that's, you know, why we have these incredibly complicated computer models, but it's different for every composite material. All right. So, so it's just really exceedingly complex.

And when composites kind of hit the collective kind of consciousness of the aerospace manufacturer, say in the '70s, they -- carbon is black, so they looked at composite really as a black metal. And they started designing

aircraft structure the way they would out of metal and they started making big pieces. And to get that structure, you kind of bend up a big piece of sheet metal, right, or used a machine on it, and they started getting spectacular failures. Fortunately, there was no deaths throughout this. But by the early '80s, the manufacturers of aircraft were saying we're done, we're not touching composite structures for our vehicles because it's too risky, it's too costly, it's too dangerous, you know, we're not taking any chances.

So the NASA put in the Advanced Composite Technology Act. Jim Starnes, a friend of mine, actually ran it, gave out contracts to Rockwell, Northrup, Grumman, Lockheed, et cetera, et cetera, a bunch of universities, all kinds of aero, and said figure this out. And by the end of the '80s, somewhere around 1990, 1991, the Building Block approach was formed. And so in short, it was formed, it was needed, because the aerospace community said they couldn't design safe structures, effective structures, from composites.

And what the Building Block approach does is it gives us -- you know, Mr. Kray calls it a philosophy, which is fine, or people will call it a formula or an approach or a process, whatever you want your word, to go through step by step by step to develop a composite material regardless -- a composite structure regardless of the material, regardless of the way it fails.

And there's all of these complex failure modes, and every new material that comes out every year is different. Regardless of what it is, it gives us this process to develop a structure that's going to meet our goals. Okay. It's going to do so cost effectively, reasonably so, depending on, you know, see how many mistakes we make along the way.

It's going to be lighter than metals, because lot of times in old days, by the time we were done fixing it, we lost the weight savings. And, obviously, most importantly for aerospace, it's going to have the safety and reliability we need. So it filled a huge gap. And once the Building Block approach went into effect, composites started gradually exploding and got to the point where they are now where they're really ubiquitous in the aerospace industry.

Q What is the role of testing analysis in this Building Block approach?

A So that's huge. As Mr. Kray described, we start off at -- you know, so there's -- just go through the screening test. We start off at -- but we start at a coupon level, very simple, flat plate models. And even at that level, we're starting to build up simple models that can predict failure under just very simple things like, you know, pulling a thing, pulling something to failure. Now put an open hole in it and pull it until it breaks, well, that's

actually a very different problem, and it's very complex. So I want to figure out how to do that, so I develop a computer model to do that.

What if I impact a composite, not even bird strike that we're worrying about, I just have runway debris, it creates internal damage. I create a model for that, very simple. Now I go to the next level where I start making -- I take a flat plate and I bolt it to a bracket or I make, you know, a curved beam or I bond, you know, an I-beam to a curved or flat plate. I do those tests. I start with my simple models and I expand them to my next level, and I see that I can predict that. And as I work my way up the Building Block, my models have all of the basics in them, and they keep adding complexity, but I'm just -- I've already got the fundamentals in them.

And as Mr. Kray said, you know, I get to this containment rig test and, you know, which is the precursor of the certification test. Containment rig tests are really expensive. Well, how did I get to containment rig tests? I had to design that part. How did I design that part? I had to use these models. So these models got developed through the Building Block approach and I verified their accuracy. I've designed this part for this $10 million test. I build it. As Mr. Kray said, sometimes it still fails, and sometimes I might go back and redesign it, but when it

failed, I update my model. So now I learned something. Why did it fail, what did I miss; I learned that. I update my model.

I now come in, my model says, well, just, you know, change this detail, make a new piece, test it. Eventually -- and, you know, Mr. Kray did it in three tests, that's -- you know, I think that's kind of ballpark typical what it's going to take at that level. I have something that I have confidence in and I'm going to spend the money to do that full-level certification. I can't do it just by models alone because they won't reflect reality. They need physical grounding and calibration. I can't do it by testing alone because it's just guesswork. It's the marriage of the two that makes it work.

Q Would you ever rely on another company's testing and testing data in building a composite part?

A No, no, absolutely not. It's a ludicrous question. No. There's way too much at stake. And, you know, as I said, composites are so complex and any little variation in my material, manufacturing processes, material handling, you know, everything can be different. So no, you do it yourself.

Q Are you aware of any expert in the field who would skip steps in this process and rely on someone else's testing data to build a composite part?

A No. I mean, the stakes are too high. You know, I mean, Mr. Kray used the word someone could cavalierly do that, and that may be the right word, but you don't find too many cavalier engineers, if you will, you don't find too many cavalier engineering companies. We think about aerospace companies as being cutting edge because they really push the technology. Space companies are exceedingly conservative because the stakes for failure are so super high. They don't take chances. GE doesn't want to put a plane (sic) on the a triple 7 and in the second year of operation have a spectacular failure. They do due diligence. Every manufacturer is the same. And so, no, they're not going to do any different.

Q Okay. So I would like to kind of just talk generally about building a composite component using this Building Block approach.

A Okay.

Q Where would you start, like with one of your projects, just give us an example, provide the Court an example, how do you begin to -- how do you start the process, what do you evaluate, what are your steps?

A All right. So think about this. So, so there's kind of a first series of issues you need to grapple with, and then there's -- once you've identified and grappled with those issues, then, there's either approach you implement.

So let me break it up. So there's a list of issues and let me just kind of think top, top issues, and let me just list them first just to get my thoughts in parts.

I'd say my top issue is certainly application, you know, where am I going, what do I want to do. And let me just list them off so I can just get it in my brain. Material, architecture, manufacturing method, I guess experience base, goal -- your goal, which I'll talk about in a minute. What else do we have here? I'd say your overall company culture is certainly important and probably your tolerance risk and things like that. All right. So let me go through that.

So you have an application. You want to build an engine. So now you kind of know what -- first of all, kind of what it looks like, curved panels, it's not all straight. Also, you're not walking in green. People who have never seen an engine or never see a composite are not doing this. So someone who's doing this knows, all right, well, you know, I need to have clearly strength, I need to have stiffness to, you know, contain the loads.

But what's probably going to be the biggest driver of my -- and we're talking about the cold end of the engine, so we're talking fan, fan and containment case. So I'm going to have bird strike is going to be clearly very important, you know, and there's a lot of dynamic and vibration

response of the blade as well as damage to the blade and certainly fan blade-out, so containment. So I know energy absorption is an important issue.

All right. So now I've already got kind of thinking in my mind, I have this application that's a drive, and I'm also thinking about what it is. You know, it's different if I'm going to design an engine for a Cessna four-passenger plane versus an Airbus A380 double-decker, right. They're different things, they're different concerns, and I'm going to go about it differently. All right. So there's my application.

Then, material, architecture, and manufacturing. Okay. So material, Mr. Kray talked about, you know, the fiber and the resin, clearly. And there's also a third material -- actually, two materials, the sizing and finishing materials that go on the fiber that promote adhesion of the fiber to the resin. So if I'm going to buy the fiber and the resin separately, I've also got to think about sizing. If I'm going to buy prepreg, the manufacturer has thought about it.

Architecture, you know, am I going to deal with a laminated material? Am I going to deal with woven? Woven, is it going to be 2D, 3D? Braided, same thing, 2D, 3D? So let's kind of just leave it at that, architecture.

Now, manufacturing method. So for these, I can make

things in a lot of different ways, right. So a laminated, I can buy a just kind of a large tape-laying machine, a 3-axis or a 5-axis machine, I can do hand lay-up. I can invest a lot more money and do a tape placement machine, which is going to be able to place small bits of fiber in a lot of different ways. And, you know, so braiding has its own methods, and woven has its own method. So there's a lot of kind of what am I willing -- what's my manufacturing methods I'm open to. All right. So those are really important, material, architecture, manufacturing methods.

So experience comes in next. What's my company's knowledge base? All right. What's my experience, what do I kind of know about this? And let me -- maybe I can go through the other ones together. So material -- let me talk about timing. So the timing is important both in terms of when I do it in physical time and what my programatic timeline is, which Mr. Kray talked about.

Physical time, you know, Mr. Kray talked about the problems of creating a -- I think he said a GE94 blade in 1990, which, you know, he said was a huge effort of $1 billion. In 1990, that was a laminated blade and it was pushing the technology. I would argue that if I would do that today, 2020, that's tried-and-true technology. There's an incredible amount of information in the literature. I can run -- computer codes are just -- I can run a computer

code on my mobile laptop work station in less time today than it took me to run on the super computer in 1990. Okay. So the technology is really different. So when you do something is very important in terms of the timing and in terms of do I also want it on the market in three years, five years, et cetera, like that.

My company culture, am I risk-taking, am I risk-adverse? Do I want to restrict myself to only a set of, you know, specific materials that I have experience with? Right. Do I want to open it up to all materials? So all of these things come into play as at a high level, I have application, I've got to decide on the scope. I've got to set the boundaries of my box, and the boundaries of my box, I'm open to anything, that means I'm not risk-adverse, I've got a lot of money to invest, right. I'm willing to try it. My goal, am I revolutionary or evolutionary?

Okay. So I have a market study. I want an engine for this aircraft. I want it in this much time. I decide with my company we're going to open it up to, you know, a series of manufacturing methods, and now I can go out and --

MR. MANGAN: Your Honor -- I'm sorry to interrupt, sir -- but I do want to object at this point in terms of, one, we're kind of getting apart from the questions. But in terms of foundation, there's been a lot of testimony from this witness about here's what an aviation company would do,

here's what they're doing, here's how they're thinking, when he just testified he's worked in academia, in research, for 30 years, and we have no testimony that he's been employed in an aviation company in the last 30-some years. So I just don't want him to get too far off of what his expertise may be.

THE WITNESS: I can address that.

THE COURT: No. It's addressed to me.

When are we going to get to the amount of the loss, if any?

MS. CORS: We are getting there.

THE COURT: The thing I have learned from this witness -- and I'm extraordinarily impressed with his background -- is the emphasis of how complex the development process is --

THE WITNESS: Yeah.

THE COURT: -- and, therefore, how valuable the intellectual property is to whomever developed it. That just makes a hundred-million loss seem insignificant to account for the true value of the design. The objection, the defendant not having had an opportunity to respond, I agree.

When are we going to get to the loss amount?

MS. CORS: We are getting there, Your Honor. It was simply to lay the foundation for what he is going to

discuss.

THE COURT: You get the drift.

MS. CORS: Yes, I do.

THE WITNESS: So then you go through the Building Block approach --

THE COURT: Excuse me, excuse me.

THE WITNESS: I'm sorry.

THE COURT: Do you have a question for the witness?

MS. CORS: Yes, Your Honor.

Q You heard testimony about the importance of resin and fibers. Can you please address from your perspective the importance of availability of fiber and which fiber you choose in this Building Block process?

A So Mr. Kray covered this. You know, different fibers, different resins, different sizings will lead you to composites with different failure modes, as I discussed, and that will drive you through a different path through the Building Block approach and will drive you -- will dictate your design, along with manufacturing method.

Q As part of your work, have you looked at the types of fibers used by GE Aviation in their development of composite engine parts?

A Yeah. I mean, for this preparation for this trial, certainly, I've done Internet searches and seen what's out there.

Q Okay. And with -- what was your finding with respect to China's access to the types of fibers that GE Aviation uses in its jet engine composite parts?

A Well, responding to, you know, C10, which is part of the Commerce Control List, it's Category 1, so the technology, pretty much any fiber manufactured after around the early 1990s is covered by CCL 1 by the fiber restriction. I know in the LEAP engine, GE's a Design 7, which would be covered by technology restriction. In GE9X, they don't publish the fiber, but they said that, you know, it was a new fiber in 2017 -- 2014, it was a new fiber. It was, you know, designed in 2015, is what's in the literature. They claimed it was a fourth-generation fiber. So that would be controlled by CCL, CCL Category 1, export controlled, and it would be well beyond what China can manufacture domestically. All of the information you can find, China is at about Generation 2 fibers, so they're talking about a Gen 4 fiber for GE9X.

Q Okay. And so just to summarize, from your review and your understanding, China did not have access back in 2017 to the generation of fibers that GE Aviation was using in the GE9X?

A That is correct. Either they -- either -- they couldn't make themselves and they couldn't purchase them, agreed.

Q Can you talk about these export controls, how about with respect to equipment and manufacturing, are there any export controls that may limit China's access to the equipment used by GE Aviation?

A Absolutely. So there's all of these different manufacturing methods, and they require a very specific equipment to do it, and there's variation within the equipment. They can buy, you know, a weaving machine from Company A or Company B and there will be differences in what I will get. But in the west, a company can go out and buy all of that manufacturing equipment for the development of -- you know, manufacturing of aerospace-grade composite structures is all export controlled, and I should add also as is nondestructive inspection equipment. And, again, you caught me going on and on, and so I'll make it quick.

I'll say nondestruction equipment, the ability to find flaws in composite materials which happens during manufacturing service is a critical part of design, and so China cannot buy the manufacturing equipment we have, you know, and GE can. And they cannot buy the nondestructive -- the inspection equipment that GE can.

Q Thank you. I would like to now turn to the Government Exhibit A, the round cost for the fan blade and containment case. As part of your work in this case, were you asked to review and evaluate Exhibit A?

A I was.

Q And can you please provide to the Court your conclusions regarding the amounts set forth in Exhibit A?

A Okay. So if you had asked me this question yesterday, you know, I would have said, you know, it's just a number, it's just some speculation, I don't know, I don't know. I agree with the individual steps that are listed, but the numbers were, you know, kind of -- could have been made up.

And Mr. Kray talked about how this applied specifically to GE9X, and I listened to his testimony. It seems reasonable. I will just say that, you know, kind of comparing where I was yesterday and today, the cost of -- you know, it says composite fan blade and case development is not a fixed cost. It depends on all of these different factors we've been talking about, you know, what material I'm going to choose, what architectures, what my company knows, you know, what my company has done before, experience. So it's -- there's an incredibly wide range of costs for engine development. For GE9X and GE's experience, this seems appropriate.

Q And as part of your work, did you also evaluate the benefit, if any, to China of obtaining information from GE Aviation regarding each of these categories?

A I did.

Q And what was your conclusion?

A Well, so I started with the knowledge that China could not get the same material system that GE could. They're starting with different material. And so by definition, right off the get-go, their material selection, first row, they have a very different suite of materials to look at. Okay. And their materials are going to respond and are going to fail very differently than the suite of materials that GE is looking at. And, remember, these failure modes are what drive your path through the Building Block approach.

All right. So thinking about that, I said, well, first of all, I think containment certification test, starting at the top, we can just take it off because it doesn't matter. Everyone needs to do a containment certification test. So I think we could just -- that's not -- if we were talking about -- I think what we're saying is, is this an appropriate cost -- and make sure I'm answering the right question.

You're saying if these costs were kind of true, so to speak, for GE, as I believe, would they be roughly equivalent for the Chinese or would they change if the Chinese knew all of the information; is that correct?

Q Yeah.

A All right. So I would say, well, they've still got to do -- they've got to choose their materials, so they've got

to do their material property and down-select from their materials. This is a fairly standard approach. I mean, you can talk -- you see it in CMX 17. I don't think there's any savings there.

Material property, FAA characterization, so I don't -- I assume that that's basically allowables testing, which is developing, you know, material strengths under different conditions as well as, you know, characterizing different batches, chemical composition, showing you can repeatedly make laminates, things like that. Chinese are using a different material, they have to do that. It doesn't matter what they know, they cannot not do that step. Okay.

Let me leave component testing for a moment. Containment rig testing. Now they've got a different material. They're going to have a -- by definition, they're going to have a different design. It's just there's no two ways about it. And so they have got to do their own containment rig testing. They're not cavalier. They're not going to go from subcomponent testing to designing a big, full-scale rig test and end testing it. So they've got to do containment rig testing, so it doesn't save them anything. So I would say Rows 1, 3, 5, 6 make no difference whatsoever.

All right. So subcomponent testing. Now I start thinking about this. Well, you know, GE has been making

composite engines for a long time, and I can look through the literature and I can see lots of subcomponent tests that are appropriate. If you asked me to build, put together, a Building Block approach, I could have subcomponent tests. Now, all right, is it possible GE has kind of some special sauce that they know a test that they haven't published, obviously, because it wouldn't be in their best interest to do so, that may be kind of -- instead of having to do these -- now, within subcomponent tests, there might be six or eight or ten tests, all right, first of all.

So does GE maybe know one that, instead of doing eight tests, I can get by with six tests? Possibly. I mean, I can't discount that. So I would say that if there's any savings to the Chinese, it's in subcomponent testing, and of this point 5 million, it's a portion of it. I don't know. So maybe they save 10 percent, maybe they save 1 out of 10 tests, maybe they save something like that, so maybe they save 500K. And then there's a sliver of design labor that they would save because they saved that 1K. So that's the kind of savings I think the Chinese would achieve.

Q And in your view, what kind of impact would that have, if any, on China's timeline for developing composite engine parts?

A None, minimal to none.

Q Okay. As part of your work, were you asked -- also

asked to evaluate the state of China's development of composite containment structures and fan blades as of 2017?

A I was. You did ask me to do this.

Q And what did you learn?

A So I did a comprehensive literature search with the focus on 2017, so saying what did the Chinese know in 2017, and the only way I can look at this is what were they publishing in the public literature, which as we know, is probably a fraction of what they know, but I don't want to surmise. I just want to say what they publicly published. So by 2017, they were pretty far along.

I mean, first of all, let me talk to the chart. Okay. So, you know, they knew how to do material properties, select. They knew how to do the first, the down-select, how to look at different materials. They certainly knew how to do material property characterization, allowable testing. They've done many subcomponent tests. Really, you can see a progression like -- let me just talk about containment rig. So in 2017, they published a subscale containment rig test. So it's really the same thing GE does, but on a scaled-down containment rig.

And that was the culmination of about four, about four different publications over the previous four or five years where you could see their progression through the Building Block approach of their -- of all of their different tests,

and you could see also the development of all of their models. So they had done all of this, they had designed this. So you can see that they had a fairly high level of sophistication, that they understood the Building Block approach, they understood the subcomponent tests they had to do, and they really were quite, you know, technologically literate and advanced on this. And I found the same thing for fan blades.

Q Do you have an opinion as to whether in 2017 China needed GE trade secrets to develop composite fan blades and encasement structures?

A No, I don't see that. I think they had -- they were already pretty much there. I mean, they had demonstrated subscale testing. They were at the point that if they wanted to put a little bit of money in and scale up what they did and go into and, you know, build this for an engine, they were ready to do so.

Q And in your opinion, given their state of development in 2017, would it have made any economic sense for China to go back to the beginning and try to replicate what GE was doing?

A I mean, no. So, so first of all, the Chinese had already moved, they were already moving along. So it was not like, you know, what they -- they were well past -- I don't know how to state this. Let me back up.

Regardless of where the Chinese were in the process, if they had obtained all of this information from GE, they could not have used GE's information as a design guide because they -- it doesn't work that way, Building Block approach doesn't work that way. There's no design guide. You progress through the Building Block approach based on what your test results give you and what your models tell you, and that gives you your next level. So there's no design guide, and they had to do what their data told them to do, okay, and they did that.

Now, by the time 2017 came along, they were already doing subscale testing. Now, they had a material that was different than GE's material. Now, why didn't they end up with the material that was like GE's material? Because they didn't have GE's material available to them. Now, maybe if they had it available to them, they would have chosen something similar.

So to do -- they wouldn't go back in time, they wouldn't say, oh, well, let's redo GE's subcomponent test, because now they would be on a parallel track. And it's a foregone conclusion, they've already figured out that's not going to work, this approach is going to work better, and they demonstrated it worked. So no, it would have slowed them down, it would have cost them money.

Q Okay. You heard some references to "prepreg." Can

you describe for the Court what that is?

A Prepreg is, like I talked about before, fibers in a laminate. So prepreg is when I buy it from a supplier with the fibers already pre-impregnated with resin, it's rolled up, so it's just kind of ready to go, to roll out and make laminated parts with.

Q And were you asked to look at whether there were any export control restrictions with respect to prepreg as part of your work?

A Yeah. I mean, I would respectfully disagree with Mr. Kray on that. My understanding of CCL 1 is that any prepreg that contains a fiber that is export controlled, that that prepreg is equally export controlled. And so I think any prepreg manufactured after, you know, like I said, early 1990s is export controlled.

Q And with respect to the GE9X engine, do you know if prepreg is even used for the composite parts of that engine?

A So GE's played that one close to the vest, understandably, but from what is out there, the GE9X uses a 2-dimensionally woven case, and my guess is it's also a woven fan blade. It certainly sounds that way from the literature, from everything that's been published.

MR. MANGAN: Your Honor, I object to the guessing that's going on.

THE WITNESS: Okay. So from what I --

THE COURT: Excuse me. Typically, I have to respond. No more guesses. I'll let it in for what it's worth. Please proceed.

THE WITNESS: So from what I can see from what's in the literature, the inference in the literature is that the GE9X blade has a woven blade that is kind of next-generation, and it uses a -- and it explicitly says they use a fourth-generation fiber. It appears -- it certainly says it's -- there's enough indication that it's not a laminated blade, it's a woven blade. I can't, can't vouch for the accuracy of what's in there, but that's my understanding from what I've read. It has absolutely been written that it's a woven containment case.

Q Okay. You heard Mr. Kray talk about sort of the internal processes that GE Aviation uses to develop composite parts. Do you have an opinion with respect to processes and what value GE's processes may have to another manufacturer?

A And I guess also if I could back up a minute to the woven case. I think it's also important that the woven case is not made with prepreg. It's actually -- you have to put your own resin in. Manufacturing a woven case is incredibly complex, and GE spent hundreds of millions of dollars working this out, and their process really cannot be replicated.

So, so if the Chinese were to make a woven case, they would be using a different material, they would be using different manufacturing equipment. They would definitely get a different weave. They would definitely get a different fiber volume fraction, different resin distribution, different resin flow, which I can go through in great detail. It would not shorten any aspect of their Building Block approach.

In terms of -- I'm sorry, ask me the question again because it was still --

Q It was the testimony regarding processes and the internal processes GE Aviation uses.

A So I guess would there be -- if the Chinese had some information on GE's internal processes, would it provide them, you know, a leg up, so to speak? And, again, beyond a few tests here and there, I don't see it because, you know, GE's internal processes really are much -- and, you know, I've worked in aerospace companies, and I consult with aerospace companies, and I deal with this all the time, and I can substantiate that, if you would like.

But companies develop these internal processes based on their institutional knowledge. So these processes tend to be very good when a company is working within its experience base, and they tend to have to be flexed a little when they go out. So the value to the Chinese of GE's

processes depends on the Chinese having materials, processes, approaches, applications within kind of GE's experience base, and I don't see that there's really a mapping there.

Q Okay. You're aware that this case, the trial, was about efforts to obtain confidential GE trade secret information regarding their development of composite fan encasements and fan blade, correct?

A Correct.

THE COURT: Are you whispering for some reason?

MS. CORS: Sorry, Your Honor. Let me speak up.

Q So you're aware that this case is about efforts on the part of China to obtain information from GE Aviation regarding its fan encasements and fan blades, correct?

A I am aware, yes.

Q Based on your testimony today and the limited value, if any, any information from GE would have had to China in their development of their own encasements and fan blades, do you have an opinion as to why another manufacturer would be interested in a company's information?

MR. MANGAN: Objection, speculation.

Q Why would you be interested in another company's information regarding their Building Block process?

MR. MANGAN: Same objection.

THE COURT: Overruled. I want to hear the answer.

THE WITNESS: Oh, well, I'm an engineer and I'm curious. I mean, I've asked before and like in my current position where I actually run a Building Block process, when I just did parts of it in academia and I consulted, there are certainly things I would ask people in the industry all the time these kinds of questions. If I'm -- and I'm involved in it now where people ask me these kind of questions. I guess from my experience, there's really kind of three, three things you're trying to get from it when you're in industry. The first are three answers you kind of expect, maybe I should say.

The first answer is they're doing things more or less the way you are, and that's just kind of a confirmation that you know what you're doing, and that's just nice because you get a warm fuzzy feeling you're doing things right. Sometimes they're doing things different, and, you know, you look at it and you talk about it with your colleagues, and you decide they're wrong, they're misguided, and, you know, and you've learned a little something. You've talked about things, you've seen different ways, and, you know, you feel also good that you really understand the process and you're ahead of this company, and that's kind of nice to know.

But there's kind of the third one, which is the one that you probably want or are looking for the most, is that this company has looked at the same kind of thing you're

doing, and they thought about it, and they come up with a little different way of doing things, and so you ask questions. And you think about that and you think about, well, can we do that, can we do things better? And sometimes the answer is yes. Sometimes the answer is no. Sometimes the answer is yes, but it's really not applicable to this particular product, but let's kind of put it in our bag of tricks. Sometimes it's yes, but, you know, we're not in that line of work. But you learn stuff and that's why you want it, that's why you ask.

Q So getting back to the information here in 2017, do you have an opinion as to the impact, if any, GE's confidential trade secret information regarding the development of their composite encasement and fan blades would have had -- the impact that would have had on China's development?

A So, you know, I've thought -- you've asked me to think about this a lot obviously to prepare, and certainly with respect to the Government Exhibit A, I saw a small, a small impact. I thought a lot about modeling. And actually I thought about the issues that Mr. Kray brought up in the sense that he's absolutely correct, there's these general purpose codes out there, like LS-Dyna and ABAQUS, and they all have to be tuned, if you will, to specific material responses, and you tune this through experiments and

obtaining model parameters and certain modeling approaches. But that tuning is material-specific, okay, so it only applies to not only the material, but the architecture, you know, and the manufacturing method. The tuning applies to all of these things.

Now, there's lots of these material parameters out in the literature for lots of different materials, I can find all of this stuff, but for some, I can't. So GE has their own proprietary manufacturing method; of course, I can't find it. But I also know that the Chinese materials are going to be different by definition because they can't get GE's. I know their manufacturing method is going to be different because GE has a custom manufacturing system that they built and it's all proprietary; and, you know, Chinese can't even buy that. So no, so their models aren't going to help them in any way.

As a matter of fact, they can get more information, they can get from here to there faster, from the open literature than they can from what GE does, and they've demonstrated that. I mean, they have these models. They have the parameters. They have the correlation of extensive experiments with their models. So, so no, I mean, maybe there's some little thing in there, but there's no game-changer here. There's nothing that would have changed the Chinese course of action or in my view significantly

changed their timeline or their cost.

MS. CORS: Thank you. No further questions.

THE COURT: Very well. Cross-examination. Brace yourself.

CROSS-EXAMINATION

BY MR. MANGAN:

Q Now, sir, let me follow up on just a few of these things. We spent a lot of time talking about the materials and the availability of materials. Bear with me. Hypothetically, if China was able to access the same material, would that change your final conclusion?

A Not significantly, no.

Q If they were able to input the same materials and have all of GE's processes?

A If they were able to access --

Q Excuse me, the inside trade secrets.

A Bear with me. If I can extend your analogy, if they were able to access the same materials, and if GE were to travel down to China and install their manufacturing equipment, their quality control equipment, their inspection equipment, ensured that they were getting the right type of weave, the right type of -- kind of in terms of resin transfer molding, the right type of resin infusion, the right type of resin distribution, the right type of fiber wet-out, the right amount -- you know, the lowest amount of

porosity, limited amount of delamination, they weren't getting, you know, fiber waviness, fiber distortions, they weren't getting race tracking, if GE worked that out for them and worked out the manufacturing method for the Chinese so that Chinese could start with the same material and get the same finished product, then, yeah, then they could use it, but I don't think GE would do that.

And I think that if the -- first of all, there's -- you know, there's hundreds of ways to do a 3-dimensional braid, and then for each one of these, there are multiple manufacturers that make these things in the US and then in China. And then, you know, that's only the first part of braiding it. So, you know, think about you've got to braid, you braid a sweater, you have a braided sweater --

Q Sir, I don't want to --

A No, so no, they don't. Go on.

Q I think you had answered it.

A Sorry, sorry.

Q All right. Let me ask you, then, certainly, there are aspects of GE's composite program with respect to fan blades and their encasements that are not publicly known --

A Yes.

Q -- would you agree with that?

A Oh, absolutely.

Q And would you agree that that fan blade and case

program that GE has is incredibly valuable in the marketplace?

A Yeah. I mean, I would agree GE has made some great advances and their engine is highly competitive and is a great value to them, absolutely.

Q With respect to composite fan blades and cases, you would say they are the leader in the industry; is that fair to say?

A That's fair to say; but it's not fair to say that I could take their fan blade and case and pop it on my engine and have a competitive engine, no.

Q Wasn't what I was asking you.

A Okay. So yeah, they're the leader.

Q Are they the only one that has the composite fan blade and case on an engine and working today that's certified?

A Yes, again, but not necessarily because no one else can. Pratt & Whitney chose to do a geared turbo fan. When GE invested in composites, Pratt & Whitney invested in geared turbo fans. They're competitive engines, different architecture. Composites doesn't mean you're the winner, it just is a approach.

Q All right. And so you think all of the competitors can do it, they just don't want to?

A I think -- well, I think, you know, it's driven by market forces, right. So Rolls Royce was going to do it,

they backed off because the market changed, but they did demonstrate technology. I think when China has the right application, I think they are capable of building a composite engine, yeah, a composite front-end cold section of an engine, yes.

Q For now as we stand here today, would you agree that that intellectual property that GE has is quite valuable?

A I would agree that GE is the leader right now in composite fan blades and containment cases, and for that matter --

THE COURT: What was the question, please?

THE WITNESS: It was -- I'm sorry.

MR. MANGAN: I believe the --

THE COURT: Would you agree that intellectual property that GE has is quite valuable?

THE WITNESS: Okay. So define "intellectual property" for me. I guess that's the problem. That's why I had a problem answering the question. So define what you mean by that term and what it encompasses.

MR. MANGAN: Well, let me move on here since you're having difficulty with these questions.

Q So let's go to the part that you -- throughout here you talked in your opinion about the information that Mr. Xu was attempting to acquire from GE. All right. And I realize originally in this case you were retained to look at

a particular PowerPoint presentation that you had received; do you recall that?

A Correct. Yes, I do.

Q That's going way back. But when you were considering what technology he was seeking, were you only thinking of that particular presentation or were you told to consider all of the information that Mr. Xu was seeking?

A It evolved. I started off with a PowerPoint, and then, you know, as you would expect, over time, I saw other information associated with a trial, yes.

Q Okay. So did they eventually give you additional communications that occurred between Mr. Xu and Mr. Zheng?

A Yes.

Q All right. Did you see the domestic requirements document that Mr. Xu had given to him which had a list of things that they were looking for?

A Yeah. It was like -- I don't know, like 60 or 69 or something like that, Exhibit 60 or 69, one of those.

Q All right. Do you remember a set of questions that asked about prepreg and what type of materials they were using?

A I do.

Q All right. Did you also look at the computer directory?

A I did.

Q Okay. So you're aware of all of that?

A I am.

Q All right. And were you also aware that Mr. Xu said to Mr. Zheng this won't be the last time we'll be meeting together, suggesting that he could collect more information?

A I do not recall that, but I -- no. I mean, I think that probably isn't anything I'm an expert on, so I might not have seen that.

Q So when it comes to the amount of information that Mr. Xu was seeking during this case, all right, do you understand, you weren't limiting it simply to the PowerPoint?

A Absolutely not.

Q All right. So you were considering it as all of the information that that employee may have had access to?

A Yes.

Q Which would have included the fan blade and the -- excuse me, the fan blade and the fan case technology that he was available to provide?

A Correct.

Q Okay. And as I understand your opinion, even if you took all of that information that GE has in their vast resources and gave it to China, it would not significantly change their program at all to develop their own engine?

A Okay. So --

Q Am I understanding that correctly?

A From what I saw -- so I will say that from the directory, I can only infer, right, what's in those files, right, because all I saw was the file names, I didn't see the files.

Q Sure.

A And, you know, my inference may differ from yours and it may differ from what was in there, but, you know, I mean, I work with people from industry and I see files like this, and I see a lot of them that don't tell me much. So there was nothing -- there was no smoking gun in anything, because that's what the defense asked me to look for in terms of, you know, do you look -- is this something we need to be really worried about our case. I mean, that's obviously what they were retaining me for.

And there was never a case where I said -- there was never a situation where I said this is critical, this would make a dramatic difference. There were a few situations where I said, yeah, they might learn a thing or two here and they might learn a thing or two there; but because it always came back to they were using different materials, different architectures, different manufacturing methods, a different application, I didn't see it, no.

Q All right. So I think you were talking about where China was within -- at least by 2017 with their own program.

A 2017.

Q And you were basing that strictly on what you saw in the published literature; is that correct?

A Correct.

Q All right. Were you basing that on media reports or anything else?

A I don't trust media reports. No, sir.

Q Okay.

A I mean, I looked at media reports, but my conclusions were always based on peer-reviewed publications.

Q Okay. So whether we're talking about 2017 or now, would you agree that currently China does not have -- they do not produce their own jet engine for either medium or large-frame planes?

A The composite, a composite jet engine, they do not produce their own composite engine?

Q With or without composites.

A Yeah. Actually, I don't know where the CJ-1000 is produced, whether it's kind of a joint effort or not. I know they have joint efforts with Russia. So I couldn't say for certain that whether they produced their own metallic engine. I never actually looked into that.

Q Okay. The 1000 was not with composites, correct?

A It was not with composites, that is correct.

Q All right. And the C-919 that was referenced earlier

is the new plane that they are trying to get launched currently, correct?

A As I understand it, yes.

Q And that's using the LEAP engine?

A Correct.

Q Right. And then they've also had separate efforts with Russia to try to develop a plane together --

A Correct.

Q -- you mentioned?

A Yeah, correct, engines, yes.

Q And again -- but, again, that has not come to fruition at this point?

A You mean the engines have not been certified? Yeah, as far as my reading of that is, those are still in development stages, agreed.

Q Is it fair to say that China still aspires to be the manufacturer of a jet engine with composite fan blades and encasements?

A You know, that's a speculation, but I would expect that China would like at some point to do this, yes, certainly.

Q But based on what you've seen in the literature, they are trying to work towards that ultimate goal?

A That's right, I would say so.

Q All right. So that would be an ambition at some point

that they're trying to fulfill?

A Certainly, certainly.

Q All right. And they are trying to get there in a variety of means; they are working on it themselves, you're saying, through the literature?

A Yes.

Q All right. They may have ways of trying to acquire the technology financially?

A Potentially.

Q Okay. And then they may also be trying to steal trade secrets as part of those efforts, fair to say?

A Potentially, yeah. I mean, that's what this trial was about, so, you know.

Q Yeah.

A And they're doing joint development with the Russians too.

THE COURT: I need to check on the interpreter's stamina. I thought I heard you winding up. How are you doing? Would you like a break?

She would like a break. How much more do you have on your piece, two or three more questions or categories?

MR. MANGAN: I could edit it down during the break, Your Honor.

THE COURT: You don't have to edit it. I am wondering if we can pop through the last few questions

before we break or not; my sense is we cannot. We'll take a 10-minute break.

Can you imagine having to interpret simultaneously and whatever the other adverb is? Thank you for your work.

We're going to recess for 10 minutes. It's a tight 10 minutes. The Internet tells us it is 2:24. We'll be back at 2:34. We're in recess until that time. Thank you.

THE DEPUTY: All rise. This court is now in recess.

(Recess taken from 2:24 p.m. to 2:34 p.m.)

THE DEPUTY: All rise. This court is in session pursuant to the recess.

THE COURT: Thank you. Please be seated. The witness can retake the stand. He remains under oath, and he understands, correct?

THE WITNESS: (Nodding head.)

THE COURT: Is that a yes?

THE WITNESS: That's a yes.

THE COURT: Very well. Does the government wish to inquire further?

MR. MANGAN: Yes, Your Honor.

Q Sir, just a few more questions. So just to understand, obviously, you're here to talk about your expertise in composites. Is it fair to say you are not an expert on China?

A Yes, that's fair to say.

Q All right. Not an expert on Chinese technology or policy?

A That's fair to say, yes. I only know what my search is.

Q Okay. Now, with respect to you were talking a little bit about -- I think you were asked on direct examination why someone would try to obtain trade secrets in this particular field; do you recall those questions, like why would they even try to do this?

A Yeah, yes, yes, asked me why, yes.

Q During your answer, you mentioned there were three different things other than curiosity?

A I was asked about information. I said why would they obtain this information. I didn't get into any, you know, trade spying, but yes, go ahead, I said that.

Q All right. But did you understand that question -- so you understood the question as to why would someone ask information about information with another company, not trade secrets, though?

A That's the way I answered the question, yes. As you said, I'm not an expert on international diplomacy, so I don't want to offer an opinion why people might engage in spycraft, if that's where you're going.

Q All right. So with respect to China at least, you

don't know why they would engage in this particular conduct?

A Well, certainly, you know, I mean, I'm aware of the news and what goes on in the world, and I'm certainly aware that there is a lot of technological espionage on the part of China. Yes.

Q All right. But in this particular case, for this technology that we've been talking about, is it fair to say that your opinion would be that acquiring that information from GE would not have ultimately helped China in its efforts to develop a similar product?

A Was that it would have small effect, yes, not that it wouldn't. Would be a small effect.

Q I think you said something marginal, something like that?

A In this particular situation, given the information that I know that was at stake, that is what I would have said, yes -- that is what I did say, excuse me.

Q So if you had a chance to talk with China, let's say, before all of this, would it have been your opinion that you're wasting your time trying to get that information from GE because replicating it wouldn't be possible?

A Because -- yes, I would have and that's, you know, right. So I obviously don't know China's motivations, but, yes, that's correct. They weren't --

Q Fair enough. You don't know their motivations, but --

A But --

Q -- by doing this, you would have told them that they're wasting their time, this would have been futile on their part?

A From what --

MS. CORS: Objection.

THE COURT: Basis?

MS. CORS: That wasn't his testimony, Your Honor.

THE COURT: Overruled. He can answer the question, if he's able.

THE WITNESS: So before, when I talked to them in your hypothetical situation, I know everything that I know now, meaning I know China's state-of-the-art, I know the kind of material that was involved in this, I knew all about technology restrictions, et cetera, that's just to frame it make sure I'm answering the right question.

Q Yes, yes.

A Okay. So I would have said here's the deal, here's where I think you are, here's what I think you might learn; you know, I don't think you're going to get a lot out of it, do what you want.

Q Okay. So even if they had gotten those crowned jewels, they wouldn't -- in your opinion, they wouldn't have been successful in being able to replicate GE's process; is that a fair statement?

A I agree, they would not have been able to replicate GE's process. I agree with that, yes.

MR. MANGAN: No further questions, Your Honor.

THE COURT: Very well. Defense wish to examine the witness?

MS. CORS: Yes, Your Honor.

REDIRECT EXAMINATION

BY MS. CORS:

Q Dr. Davidson, an engine has many parts beyond just a composite fan blade and encasement of fan blade, correct?

A Absolutely.

Q And with respect to China's development of a fully functioning jet engine with composite encasement, composite fan blades, it's possible, isn't it, that the reason they don't have a fully functioning jet engine is due to issues with other parts of the engine, not the composite containment casing and fan blade?

MR. MANGAN: Objection, speculation.

THE COURT: The objection is speculation, and it's overruled. I want to hear what this witness says. The question was -- you can roll it down for me, ma'am.

THE STENOGRAPHER: Okay.

MS. CORS: Okay. You've testified that -- oh, I'm sorry.

THE COURT: And with respect to China's development

of a fully functioning jet engine with composite encasement, composite fan blades, it is possible, isn't it, that the reason they don't have a fully functioning jet engine is due to issues with other parts of the engine, not the composite containment casing and fan blade?

THE WITNESS: Yes. And you asked me to look into this as part of the -- as part of my research, and from what I gather from the literature, as well as political analysis from military experts and technology experts that are -- that have been published, China lags the west in the development of the hot section of the engine by a significant margin.

As a matter of fact, there are people that would argue that the technology in the hot section of the engine is not only the most complex in the engine, that it's the most complex materials technology on the planet. You know, they engineer almost -- they design parts atom by atom on super computers, and GE is pretty darn good in this and the west is pretty darn good on this. And the benefit of composite cold -- you know, front-end cold section is really largely obtained -- the better your hot section is, the more sense it makes for you to go to a composite front end.

THE COURT: The answer was yes?

THE WITNESS: The answer was yes. Thank you. See, he's getting to know me.

Q One final question. Dr. Davidson, you just heard Mr. Mangan refer to GE's "crowned jewels," the information that they have, confidential information relating to these composite materials used in jet engines.

In summary, I know you've already testified about this, but do you believe there's any game-changing crowned jewel information at GE Aviation that could have had a substantial impact on China's own development of its containment casing and fan blades?

A Given the constraints of China, you know, having the limitations it does due to export controls, I don't see it, no. I would say no, there is not.

MS. CORS: Thank you. No further questions, Your Honor.

THE COURT: Recross?

MR. MANGAN: No, Your Honor. Thank you.

THE COURT: You appear to have survived.

THE WITNESS: Barely.

THE COURT: You are free to step down. Are you flying home?

THE WITNESS: Not until tomorrow.

THE COURT: Do you know the fan blades?

THE WITNESS: No, but I'll take a good look, but, see, I have bigger concerns because I taught undergrad aerospace engineers, so I might stop flying altogether.

THE COURT: I wish you the best. You may step down, sir. The witness is free to go, from the government's perspective?

MR. MANGAN: Yes, Your Honor.

THE COURT: The defense as well?

MR. MIEDEL: Yes, Your Honor.

(Witness left the stand.)

THE COURT: Okay. From defendant's perspective, you have concluded your evidentiary presentation for today; is that right?

MS. CORS: That's correct, Your Honor.

THE COURT: The government as well; is that right?

MR. MANGAN: That's correct, Your Honor.

THE COURT: All right. So we have gotten the evidentiary hearing under our belt. I told you when we started, I would like written argument on this, and I would propose that you incorporate it into your sentencing memorandum. And in terms of sentencing memorandum, I'd like it due -- typically, it's three days before sentencing. I'd like it due at least a week before; and in looking at the calendar, I would hope we could do that by September 23rd, if we get a transcript of these proceedings in one to two weeks. So I wonder if we can start to consider whether October 3rd or 4th would be an appropriate sentencing date?

Does the government have any ration from the collective

seat of your pants?

MR. MANGAN: Could we have one moment, Your Honor, just on the date?

THE COURT: Yes, yeah.

(Pause.)

MR. MANGAN: Your Honor, Mr. McKenzie will be in trial, and Ms. Glatfelter will be out that entire week. I'd like to at least have, you know, one of them be able to attend. Is it possible to do it the week after?

THE COURT: I don't know. We'll have to look at the calendar. I don't think so. How about do it the last week of January or any week in February?

MR. MANGAN: That might be another trial, Your Honor.

THE COURT: That was a joke.

MR. MANGAN: I know.

THE COURT: We'll look at our calendars. That's what we're doing. What's the defense's sense of timing, seat of the pants?

MR. MIEDEL: Well, I was going to say that that week is also not ideal for us.

THE COURT: Okay.

MR. MIEDEL: The following week would be good, the week of the 10th. Obviously, the Court can receive these submissions however you want. It seemed to us that it might

make sense to do a post-hearing submission on the loss issue because, obviously, it could make a huge difference in terms of what the ultimate guideline is. Our sentencing memo might look vastly different if it's one thing versus another in terms of asking for downward departures and that sort of thing. But if you want to put it all into one, we will make that work.

THE COURT: We'll get back to you.

MR. MIEDEL: Okay.

THE COURT: This has been helpful today. I would like the transcript prepared, and I'll be in touch with you. And I need to go inspect some fan blades. So it's been a high honor and great privilege to have this recurring nightmare back, and I will see you in due course. We'll rise as we adjourn.

THE DEPUTY: All rise. Court is now adjourned.

(Proceedings concluded at 2:46 p.m.)

C E R T I F I C A T E

In accordance with 28 U.S.C. Section 753, I certify that the foregoing is a correct transcript of the record of proceedings in the above-entitled matter prepared from my stenotype notes and that the transcript page format is in accordance with the regulations of the Judicial Conference of the United States.

/s/ Lisa Conley Yungblut 08/31/2022

LISA CONLEY YUNGBLUT, RDR, RMR, CRR, CRC DATE

I N D E X

E X H I B I T S

GOVERNMENT'S	IDENTIFIED	ADMITTED
Exhibit A	18	(Previously)